FD

AMC PAMPHLET **AMCP 750-3**

AD737591

MAINTENANCE OF SUPPLIES AND EQUIPMENT

USER'S GUIDE FOR ARMY DEPOT TRANSPORTATION SIMULATION MODEL

HEADQUARTERS, U.S. ARMY MATERIEL COMMAND **FEBRUARY 1971**

65

HEADQUARTERS
UNITED STATES ARMY MATERIEL COMMAND
WASHINGTON, D.C. 20315

AMC PAMPHLET
No. 750-3

26 February 1971

MAINTENANCE OF SUPPLIES AND EQUIPMENT

USER'S GUIDE FOR ARMY DEPOT TRANSPORTATION SIMULATION MODEL

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1-1. Purpose and scope. a. The purpose of this pamphlet is to provide a description of the Army Depot Transportation Simulator and instructions for its use. Chapter 2 contains a description of the simulator's functional logic and a description of the output reports. Chapter 3 contains a brief description of the SIMSCRIPT Programming Language. Chapter 4 describes the input data requirements of the simulator and presents some tables which assist the user in the organization, documentation, and initialization of the data inputs. Chapter 5 describes the LIST output program and the instructions for its use. Chapter 6 describes the Vehicle Utilization Report and presents the instructions for the use of the UTIL output program. Chapter 7 describes the Cargo Report and presents the instructions for the use of the CARGO output program.

b. This pamphlet applies to Headquarters, U.S. Army Materiel Command (AMC); AMC major subordinate commands; project/product managers; and separate installations and activities reporting directly to Headquarters, AMC.

1-2. The Requirement for Support Modeling. a. AR 750-6 requires that support planning for major development projects qualifying for contract definition or other projects, as appropriate, will employ support models which will:

(1) Facilitate the analysis of factors related to alternative support concepts and the selection of the optimum support concept for the equipment being developed or purchased.

(2) Project availability and operational readiness float for the end item or major component.

b. In order to provide AMC commodity commands and project management offices with logistic support models which would satisfy these requirements, an investigation of currently available models was initiated. This investigation led to the uncovering of the PLANET (Planned Logistics Analysis and Evaluation Technique) system of logistics support simulation models developed by the Rand Corporation for the Air Force. This system of simulators as developed by Rand consists of four simulators and a set of reports and analysis routines called the Reports and Analysis Library.

c. The first of these simulators, the Availability and Base Cadre Simulator (ABC), was designed to simulate ''Air Force Base-level'' on-equipment unscheduled maintenance and scheduled maintenance support of aircraft or fixed missile systems. Its Army equivalent would have been organizational, direct, and general support of unscheduled on-equipment and scheduled maintenance support of a system. The second simulator of the series, the Bench Repair Simulator (BR), was designed to simulate ''Air-Force Base-level'' off-equipment repairs. Its Army equivalent would be the off-equipment repair activities of the organizational, direct, and general support levels. The third and fourth simulators of the series are, respectively, the Depot Transportation Simulator (DT), and the Depot Repair and Overhaul Simulator (DR&O). The DT simulates the transportation of reparable and serviceable repair parts between the installations and the depots, and the DR&O simulates depot level repair and overhaul activities. The respective equivalents of these two simulators in the Army would obviously be similar.

d. During the course of the investigation of logistic support models, trial applications of the ABC, the BR, and the DR&O simulators were conducted for the purpose of evaluating them for use by the Army. As a result of these applications and evaluations of the functional logic of the simulators, it was determined that:

(1) The ABC Simulator, as developed by Rand, could be used to simulate Army fixed missile and communication system and aircraft system support when support planning envisioned the combining of organizational, direct, and general support at the same physical location.

(2) However, for weapon systems whose support planning envisions support characterized by the Army's standard echeloned support structure of organizational, direct, and general support at different physical locations, and whose mission plans are characterized by intermittent missions of long duration relative to aircraft missions (for example, tanks, personnel carriers, recon-vehicles, mobile guns, and other mobile ground equipments), the ABC simulator would require rather extensive modification.

(3) Similarly, it was learned that minor modifications of the BR, DT, and DR&O would improve their effectiveness for Army use and at the same time alleviate some of the difficulties in their use which arose from differences in Air Force and Army terminology and jargon.

e. For these reasons, it was decided to accomplish the necessary modifications to each of the PLANET simulators and publish four AMC pamphlets containing a description of the modified simulators and instructions for their use as deemed appropriate by AMC commodity commands and project management offices. This pamphlet is the third in the series of four pamphlets to be published by AMC.

1-3 Acknowledgement of the PLANET System of Simulators. a. This pamphlet contains a description and instructions for the use of the modified Depot Transportation Simulator of the PLANET system of logistic support simulation models developed by the Rand Corporation.

b. Description and instructions for use of the original PLANET system of simulators can be obtained from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314, AUTOVON 555-1850, using the following AD request numbers. Cost per hard copy is $3.

AD No.	Publication
810908	PLANET: Planned Logistics Analysis and Evaluation Technique
658413	PLANET: Part I - Availability and Base Cadre Simulator
655769	PLANET: Part II - Bench Repair Simulator
657012	PLANET: Part III - Depot Transportation Simulator
673339	PLANET: Part IV - Depot Repair and Overhaul Simulator
683422	PLANET: Part V - Report and Analysis Library

c. Magnetic tape copies of the source programs for each of the original PLANET simulators and for the modification of the ABC simulator are available upon request from the AMC Maintenance Support Center, Applied Science Division, Letterkenny Army Depot, Chambersburg, Pennsylvania 17201, AUTOVON 242-7739.

CHAPTER 2

DESCRIPTION OF THE DEPOT TRANSPORTATION SIMULATOR

Section I. SIMULATOR

2-1. General. a. In establishing and operating a transportation system,a planner faces a number of problems. Given cargo estimates and the distances to be traveled, what mode of travel should be used? What priority should the cargo have? How large should the transport vehicle be? What should the transit schedule be? How will the planner operate the transportation system within some given cost?

b. The time required to move cargo from place to place, sometimes referred to as a part of the logistics "pipeline time," usually influences logistic resource requirements. To illustrate: for a given demand rate, the longer the pipeline time, the more spare parts required to provide the same level of protection against stockouts. One of the logistics problems is concerned with the trade-off between transporation costs and resources. The Depot Transportation Simulator (DT) considers the transportation system necessary to move a weapon system's reparables and serviceables from place to place, as from the support installation to a depot or factory and return to user.

c. The simulator takes, as inputs, various operating characteristics of the transportation system — the expected cargo to be moved through a period of time and a planned set of transportation vehicles. It then simulates the operation of the system through the time period and records the data, from which reports can be printed, that reflect the performance of the transportation system under the conditions specified. Performance is measured in terms of the amount of different priority cargos moved during the simulation.

d. The outputs from the simulator can be used as an aid in determining both the quantity of resources that can be moved over a simulated period of time and the costs associated with the operation of the system. Normally, an initial target transportation time is set when estimates of weapon system performance are gross. As these estimates improve with experience, the economy of the initial target times can be reevaluated in terms of the cost of additional supplies and slower transportation, so as to achieve an economic balance between the two. For example, what if the spare parts for a new weapon system are procured on the basis of the reliability to be obtained after several years of operation? When the weapon system first becomes operational, its reliability may be low, causing a high NORS (not operationally ready — supply) rate. Expedited transportation may be the answer. Later, if reliability reaches its expected value, a fleet of trucks (instead of airplanes) may be sufficient, based on the supplies already procured for the weapon system.

2-2. Functional Description. a. The Depot Transportation Simulator can be used to simulate the movement of various types of cargo or logistics resources necessary to support a given operation. Figure 2-1 is a diagram of the transportation process, oriented toward the way in which a cargo carrier will move through the system.

b. The term "resource" has been previously defined. Specifically it can represent personnel, a spare part, a pallet, or any heterogeneous substance that is to be moved from place to place. As long as the unit can be defined by its weight and volume, it can be considered a resource in the simulator.

c. Transport vehicles are defined by their velocity and cargo-carrying parameters. There can be any number of vehicles of different types — aircraft, land vehicles (trucks, jeeps, etc.), or ships. The routes of the vehicles are preassigned and any installation may be designated as the home installation for each carrier. The locations of all installations that transport vehicles may visit must be specified in the simulator. It is usually convenient to specify the location of each installation by its longitude and latitude; however, any system for locating installations is satisfactory, provided the distances between points are specified in the same terms as the velocity of the transport vehicle.

d. Three types of runs can be specified during the simulation: (1) a cyclic run, in which a vehicle will follow an assigned route and schedule, arriving back at the home installation after some expected period of time, and in which the route and schedule are repeated at regular intervals; (2) a special run, in which a carrier is dispatched to an installation to pick up "special" cargo (e.g., hazardous or very expensive cargo); and (3) a run requiring a special carrier such as a carrier for outsized cargo. A special carrier can also transport regular or normal cargo if there is room,and if it has been specified that this type of operation will be permitted.

e. In the following description of figure 2-1, only cyclic runs will be discussed, not special runs.

(1) The transport vehicle leaves its home installation (1) for some preassigned destination (4). While en route (2), there is some probability of delay or loss of vehicle and cargo (3) due to weather, accident, etc. Upon arrival (4), the cargo assigned to the installation is offloaded (5). The time the offload requires is drawn from a distribution or specified in the input as a standard value. The assigned cargo is then moved to the installation stock (6).

(2) Upon completion of the offload, the vehicle is serviced and maintenance is performed if necessary (7). The time to perform these actions can be drawn from a distribution or can be a standard time. If the carrier requires an inordinate amount of maintenance and will not be able to maintain its schedule, another carrier, if available, can be dispatched as a replacement.

(3) Meanwhile, the cargoes to be shipped to the depot have been moved from the installation storage area to the loading dock (8 and 9). When the transport vehicle is ready, it is loaded (10) with cargo and the carrier will leave for its next destination (11).

(4) The sequence of events, "in-transit" to "next destination" (2 and 11), is repeated until all scheduled stops have been made. The vehicle visits installation, discharges the assigned cargo, picks up cargo to be moved, and proceeds to the next installation until the scheduled "circuit" is completed.

(5) After the arrival at and departure from the final installation (11), the vehicle is dispatched back to the home installation (12, 13, and 14) where all remaining cargo will be offloaded.

(6) The reparables assigned to the depot or factory are moved to the repair line (16) where the repair or overhaul process time (17) is computed. Upon completion of the

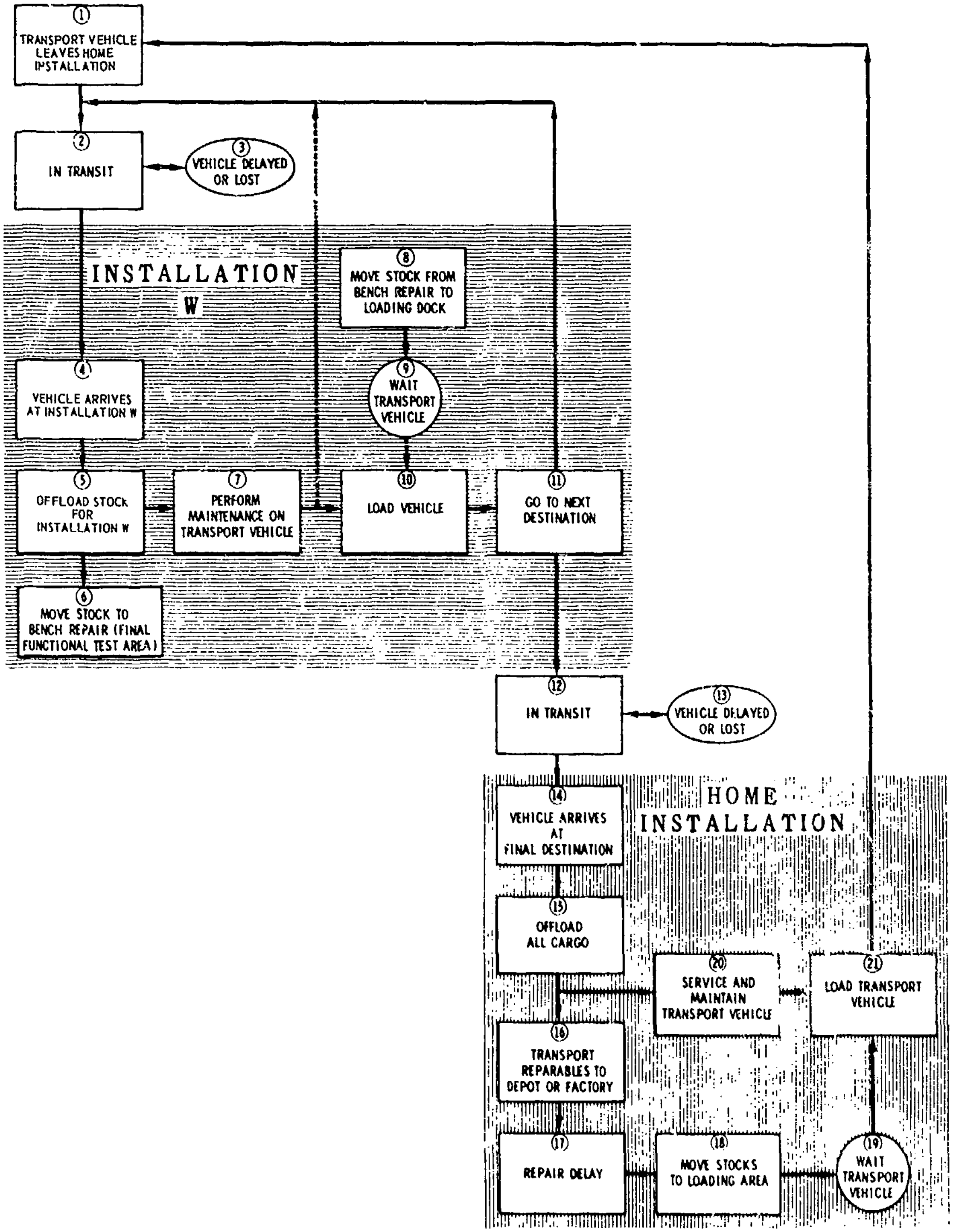


Figure 2-1. Depot transportation process.

repair (17), the reparables — now serviceables — are moved to a loading area (18) to await the availability of a transport vehicle (19).

(7) Following the offload of the cargo (15) at the home installation, the transport vehicle is serviced and subjected to maintenance as required (20). The vehicle is then loaded with the assigned cargo to be moved (21). Thus, the circuit is repeated.

2-3. Simulation Logic. a. The Depot Transportation Simulator is designed to simulate the movement of logistics materiel through a transportation network. The network may consist of as many different load and unload points as desired. Army materiel can be any substance that can be defined by its weight, volume, and, if necessary, special handling requirements. Figure 2-2 is a logic diagram of the Depot Transportation Simulator oriented toward the way in which the transport vehicle will move materiel through the transportation network.

b. When the materiel is ready for shipment, tests are made to determine if special handling is required (e.g., by an extra long truck or a specially modified airplane or helicopter), or if the cargo is to be shipped by a special run (e.g., hazardous, very expensive, or high priority cargo). If special handling is required, the program will search for an available carrier of the required type. If special handling is not required, or if a special carrier is not available, the resource(s) will be filed in a queue ranked on priority.

c. Meanwhile, carriers are being delayed for servicing before they depart on the next leg of their circuit. After a servicing time delay, the awaiting cargo is loaded. If more cargo is to be shipped than the carrier can handle, the cargo is loaded in the sequence in which it was filed in its queue until the carrier is full.

d. When loading is completed, the carrier is dispatched on schedule to its next stop. While en route a test is made by the program to determine if the vehicle will encounter a delay or be lost (along with all of its cargo) for the duration of the simulation. The probabilities of delay and/or loss are an input.

e. When the carrier arrives at its next destination, the cargo assigned to that installation will be unloaded. The required time is drawn from a distribution. The program then tests to determine if the carrier has arrived at its home installation. If not, the cycle is repeated as scheduled. The carrier is serviced and loaded (time distributions) with cargo and proceeds to its next prescribed destination.

f. Upon arrival at the home installation, all cargo is unloaded and scheduled maintenance is performed on the carrier, if required.

g. Following a maintenance time delay, the program tests to determine if a special dispatch is required of this carrier. If not, it joins the pool of "available" carriers at its home installation.

Section II. OUTPUT PROGRAMS

2-4. LIST. a. Given a set of resources to be moved and estimates of transport vehicle performance, the Depot Transportation Simulator simulates the operations of a system under a similar set of conditions.

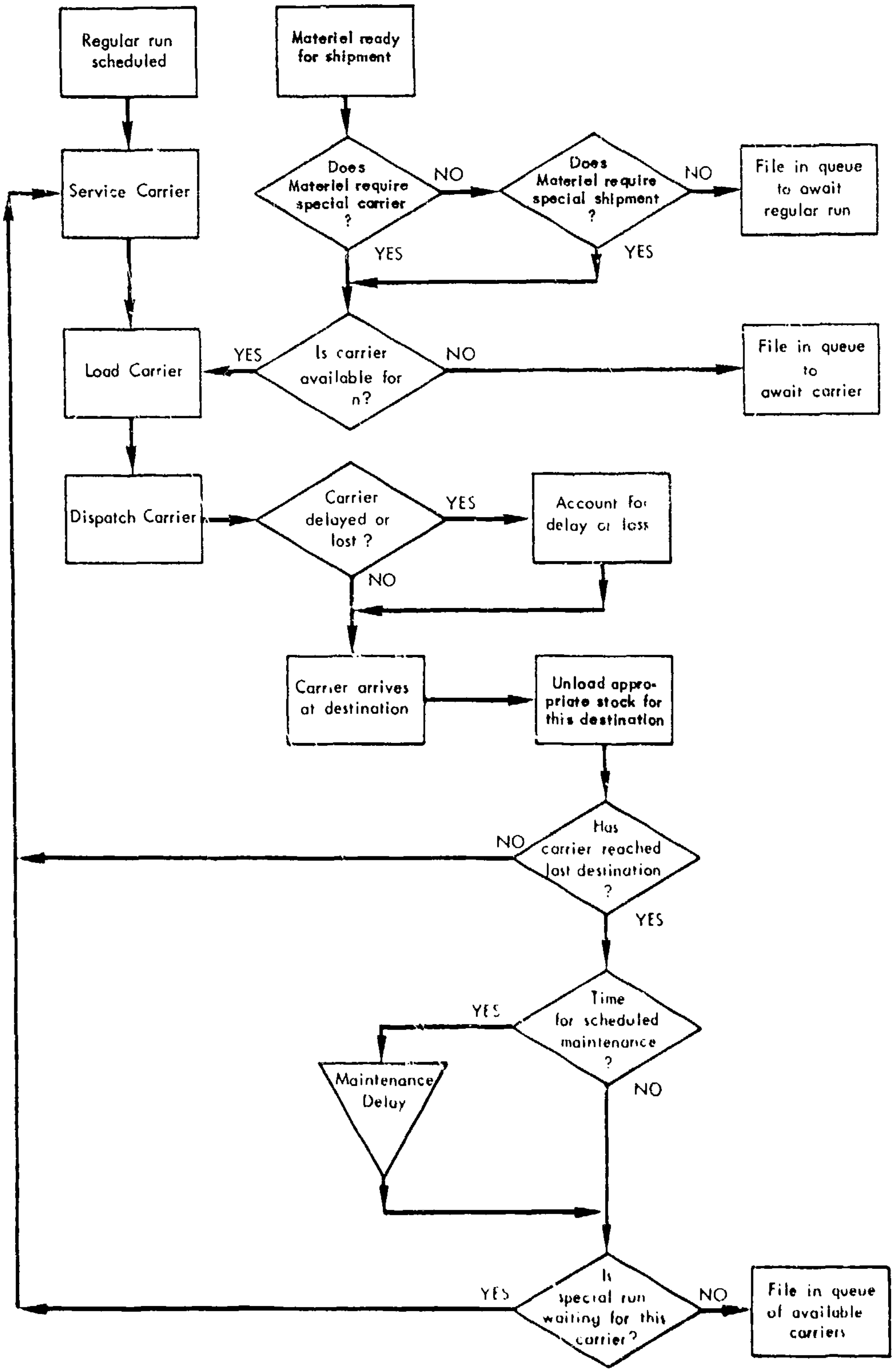


Figure 2-2. Depot Transportation Simulator Logic.

b. These experiences (or interactions between events and system status) are accumulated during the simulation, and selected variables are recorded on a magnetic tape. The output programs can be used to prepare reports of selected variables at any time interval the user designates. The bulk of data available for accumulation, collation, comparison, and analysis suggests a wide spectrum of applications. Naturally, different problems require different analysis programs. Output can be used to evaluate the performance of the system under study. Appendix F lists the kinds of data contained in the simulator output.

c. The output program LIST can be used to produce a listing of the tape created by the Depot Transportation Simulator. This output listing is intended to indicate only the kinds of raw data contained in the simulation run. From these data, reports can be generated.

d. Two reports are available for use with the Depot Transportation Simulator — the Cargo Report and Cargo Carrier Utilization Report. Undoubtedly, these reports will not cover all the problems that can be envisioned for depot transportation. In such cases,the user can modify the existing program, or program a new report.

2-5. Cargo Report. The Cargo Report, produced by output program CARGO, displays the quantity of cargo moved throughout the simulated period (see appendix I). The quantity is specified in terms of weight, volume, and units for each type of cargo. Note the separate specification of both the quantity of cargo that is loaded aboard some carrier (TP), and the quantity of cargo delivered (TD) by a carrier. The same distinction is made for installation deliveries (col 4), and for the depot (col 5). Column 6 specifies the quantity of each cargo type that is in-process (in-transit) as of the report time.

2-6. Cargo Carrier Utilization Report. The Cargo Carrier Utilization Report, produced by output program UTIL, displays the utilization of each vehicle (by ID number) for each vehicle type throughout the simulated period (see appendix H). For each vehicle, column 3 lists the time the vehicle was available for service, column 4 the time lost due to maintenance, and column 5 the time involved in loading the vehicle. Idle time, listed in column 6, is the report interval time minus the sum of maintenance, loading, and in-transit times. The utilization factor is the sum of maintenance time, loading time, and in-transit time, divided by the total simulated time to date.

2-7. Depot Transportation. The Depot Transportation outputs have several potential uses for the analyst. For example, he can estimate the required capacity of a transportation network for a given amount of resources to be moved and a given procedure and schedule. Or, if resupply time is to be the measure of effectiveness for a supply system, and the repair cycle time for some given reparables is known, the required efficiency of the transportation system may be determined.

2-8. Conclusion. a. In conclusion, two brief precautions are in order. First, the user should be confident that his inputs are realistic. If these estimates are apriori in nature, he may wish to consider a range of values for those input variables he is unsure of — that is, subject them to a controlled sensitivity analysis. If system performance is relatively insensitive to changes in these variables, the user may assume that the initial values are satisfactory with no great loss of accuracy if they later prove otherwise. If the reverse is true, it would be advantageous to get better estimates, if possible. Unrealistic inputs lead to misleading outputs.

b. The user should also consider sample size. Simulation runs that have obvious misallocations may provide useful outputs with a relatively small sample size. But as the balancing process progresses, the interrun differences in system performance become smaller (or less significant) for different resource mixes, and the sample size will have to be relatively large before the analyst can determine the true significance of these runs.

CHAPTER 3

SIMSCRIPT PROGRAMMING LANGUAGE

3-1. General. Although a knowledge of SIMSCRIPT is desirable, it is not essential to the successful operation of the Depot Transportation Simulator. This section contains a general description of SIMSCRIPT with appropriate instructions to complete the Data Deck required to execute the simulation.

3-2. Entities, Attributes, and Sets. a. A SIMSCRIPT simulation program consists of a numerical description of the "status" of the system. This status is modified at various points in simulated time as events occur. Event routines describe how the status changes. The "status" of the system is defined in terms of what are called entities, attributes of entities, and sets of entities.

b. Any unit independently identified in the simulation, such as "Item of Cargo," "Transport Vehicle," or "Installation" is called an entity. Each entity is, in turn, described by enumerating its particular attributes. The attributes of an item of cargo might be its weight, volume, origin installation number, and destination. One attribute of a transport vehicle might be its cargo-carrying capacity.

c. A status description may comprise any number of different types of entities; there can also be any number of entities of a particular type. Entities are considered the same type if their attribute names are identical; the values of these attributes may, of course, be different.

d. Entities may be grouped in sets. An entity may belong to any number of sets and may own any number of sets. Entities are readily inserted or removed from sets on a "first-in-first-out," a "last-in-first-out," or a "ranked" basis by which the entity's ranked position is determined by the value of one of its attributes.

e. The Depot Transportation Simulator is built according to this structure. SIMSCRIPT requires the simulation designer to state the significant events that will take place in the operation of the system, and to name the entities of the system that either perform or are affected by the actions described in the event statements. The event statements are written as a logical sequence of steps, or a program, depicting all alternative actions that may occur during the time the event occurs. Each entity is described by listing certain of its attributes so as to represent, in the computer program, all physical characteristics significant to the measurement and prediction of system performance. Although it is usually necessary within each event to arrange for some future event to occur (thus providing continuous system operation), the program writer is not required to sequence the future events. The SIMSCRIPT control program automatically constructs the proper chain of simulated events in simulated time order.

f. During a simulation run, various events occur that change an entity's status. For example, a shift-change event will make particular carriers available or unavailable, depending on whether they are scheduled during the new shift. Each different type of event has a written routine that describes how the entity status changes when this event occurs. These event routines (and the subroutines that they call) compose the simulation program.

g. As of any particular moment in simulated time, the status of the transportation system is described in terms of what entities exist, what the current values of their attributes are, what sets they belong to, and what sets they own. Each kind of event may occur repeatedly and at any desired points in simulated time. Some may occur exogenously, caused by data inputs outside the simulation process. Others may occur endogenously, caused by preceding events within the simulation process.

h. All SIMSCRIPT I.5 source programs are compiled into an object program. An earlier version of SIMSCRIPT required source programs to be translated by SIMSCRIPT into FORTRAN source programs, which were then compiled by the FORTRAN monitor into a FORTRAN object program.

i. The general card order of a SIMSCRIPT job is pictured in figure 3-1. The Control Cards will vary according to the system requirements of a particular installation. The Definitions Deck is punched from data on the SIMSCRIPT Definition Form (see figure 3-2). The Definition and Source Decks make up the Depot Transportation Simulator Program.

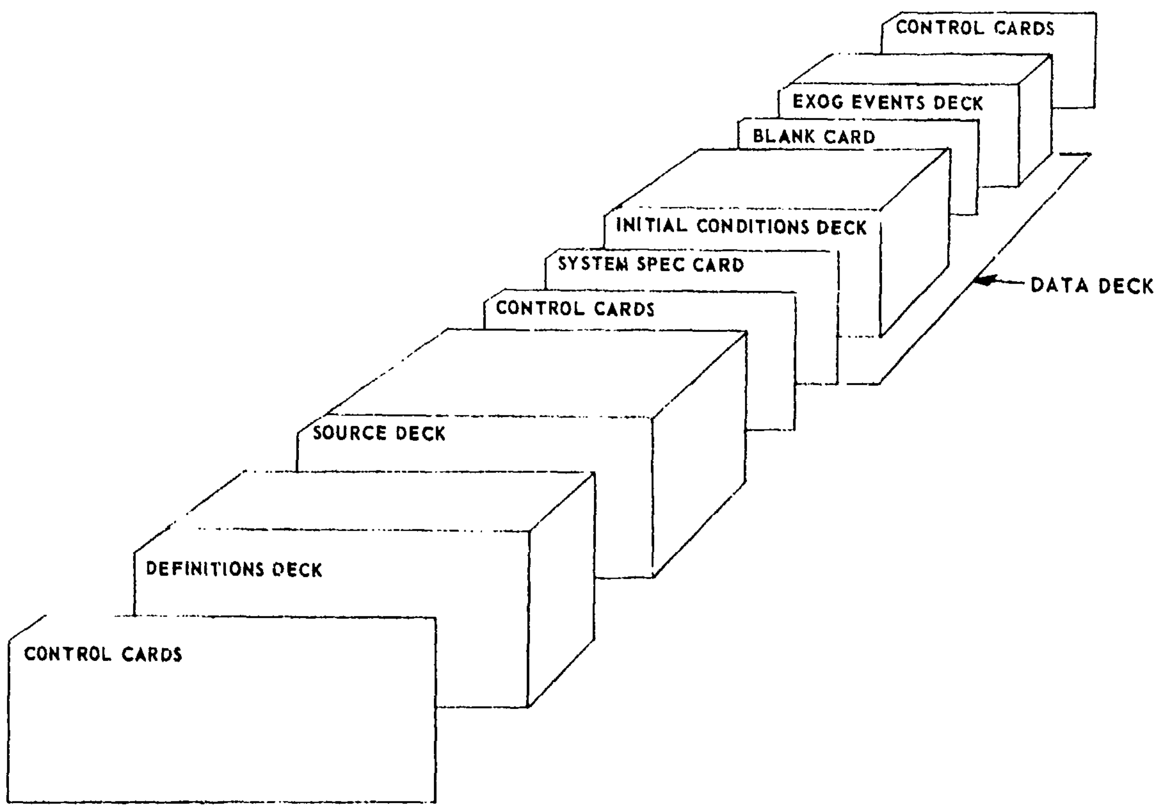


Figure 3-1. General card order of a SIMSCRIPT job.

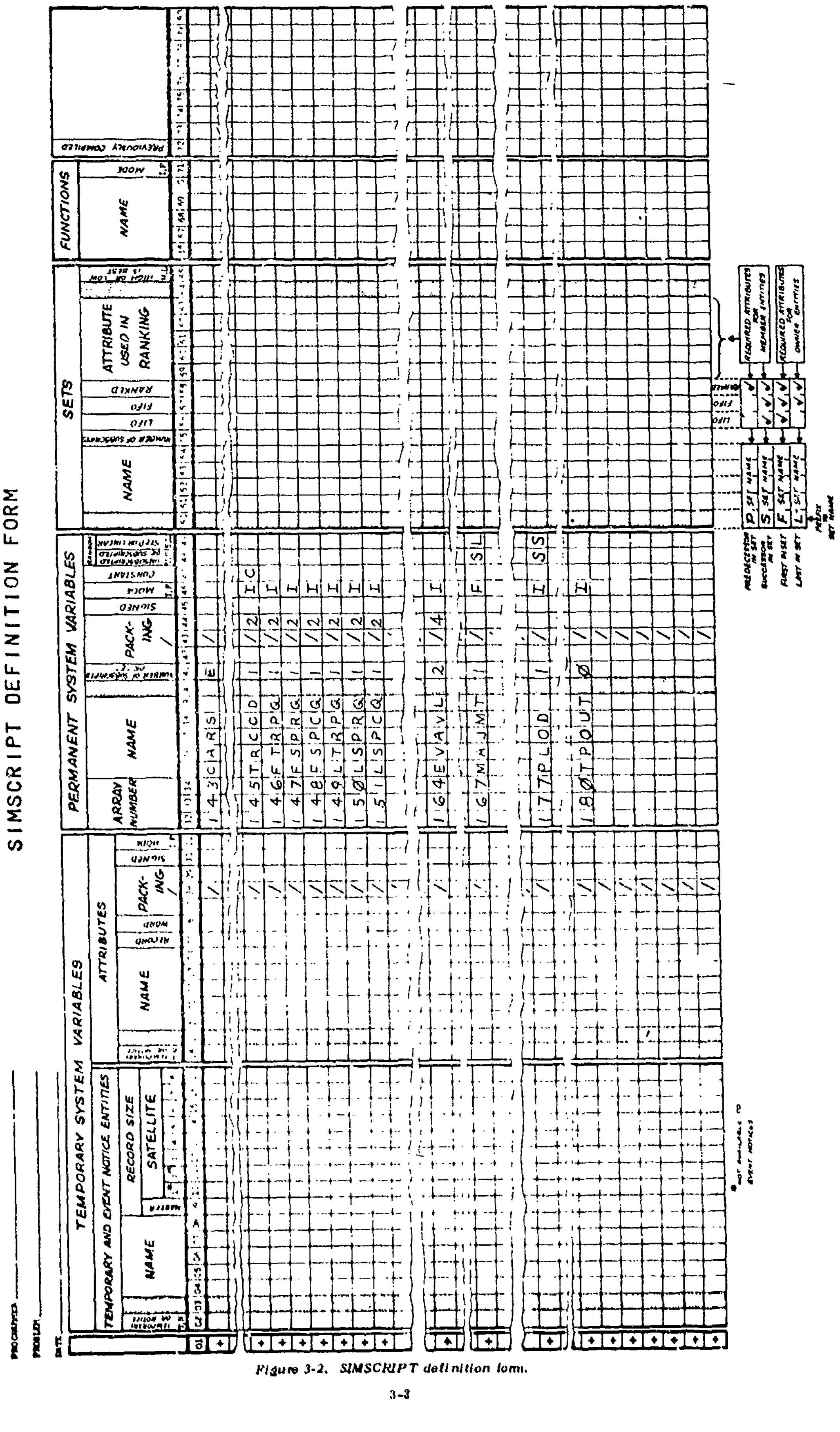


Figure 3-2. SIMSCRIPT definition form.

3-3. Data Deck. The first card in the Data Deck is the system specification card. See top of figure 3-3. The number "1" must be in column 1. A punch in column 6 will cause the Initialization Deck to be printed. Columns 7 through 12 contain the "Maximum Array Number" contained in the Initial Conditions Deck. For the Depot Transportation Simulator, the maximum array number is 180.

3-4. Initial Conditions Deck. a. The Initial Conditions Deck consists of data cards plus initialization cards punched from the SIMSCRIPT Initialization Form shown as figure 3-3. Every array number from 1 up to the largest appearing in columns 32-34 of the Definitions Deck (see figure 3-2) must be accounted for in sequential order in the initialization cards.

b. Procedures for preparing the Initial Conditions Deck are discussed under the following headings:

Unsubscripted Permanent Attributes and Entities

Single — Subscripted Permanent Attributes

Double — Subscripted Permanent Attributes

Random Look-up Tables for Subscripted Attributes

3-5. Unsubscripted Permanent Attributes and Entities. a. Each unsubscripted permanent attribute and entity defined on the Definition Form must have its initial value read in or set equal to zero. Initial values of unsubscripted permanent attributes or entities may be separately specified by means of individual initialization cards, or they may be handled in groups by means of a single initialization card followed by data cards. To be initialized as a group, the system attributes in the group must have consecutive array numbers. Their values must also be read in by using the same Format statement Field Description.

b. Figure 3-3, LN1, is an example of the entries required to read in the initial value of a single system attribute or entity:

Cols 1-4	Array Number. Enter the array number of the attribute or entity to be initialized. The unit's position of the array number must be in column 4.
Col 10	Number of Subscripts. Enter "O" to specify an unsubscripted array.
Col 12	Read-in Values. Enter an "R" to specify that an initial value is to be read in.
Cols 50-66	Initial Value. Enter the initial value as an integer or decimal number anywhere in columns 50 through 66. Formats, other than integer or decimal (e.g., hours or alpha-numeric), must be read from data cards as shown in LN2.

c. The initial value can be set to zero by entering a zero in columns 50-66, or by leaving column 12 blank and entering a "Z" in column 13. If all the values of a group of consecutively numbered system attributes are to be set initially to zero, the lowest and highest array numbers are indicated in columns 1 through 8, and "Z" entered in column 13.

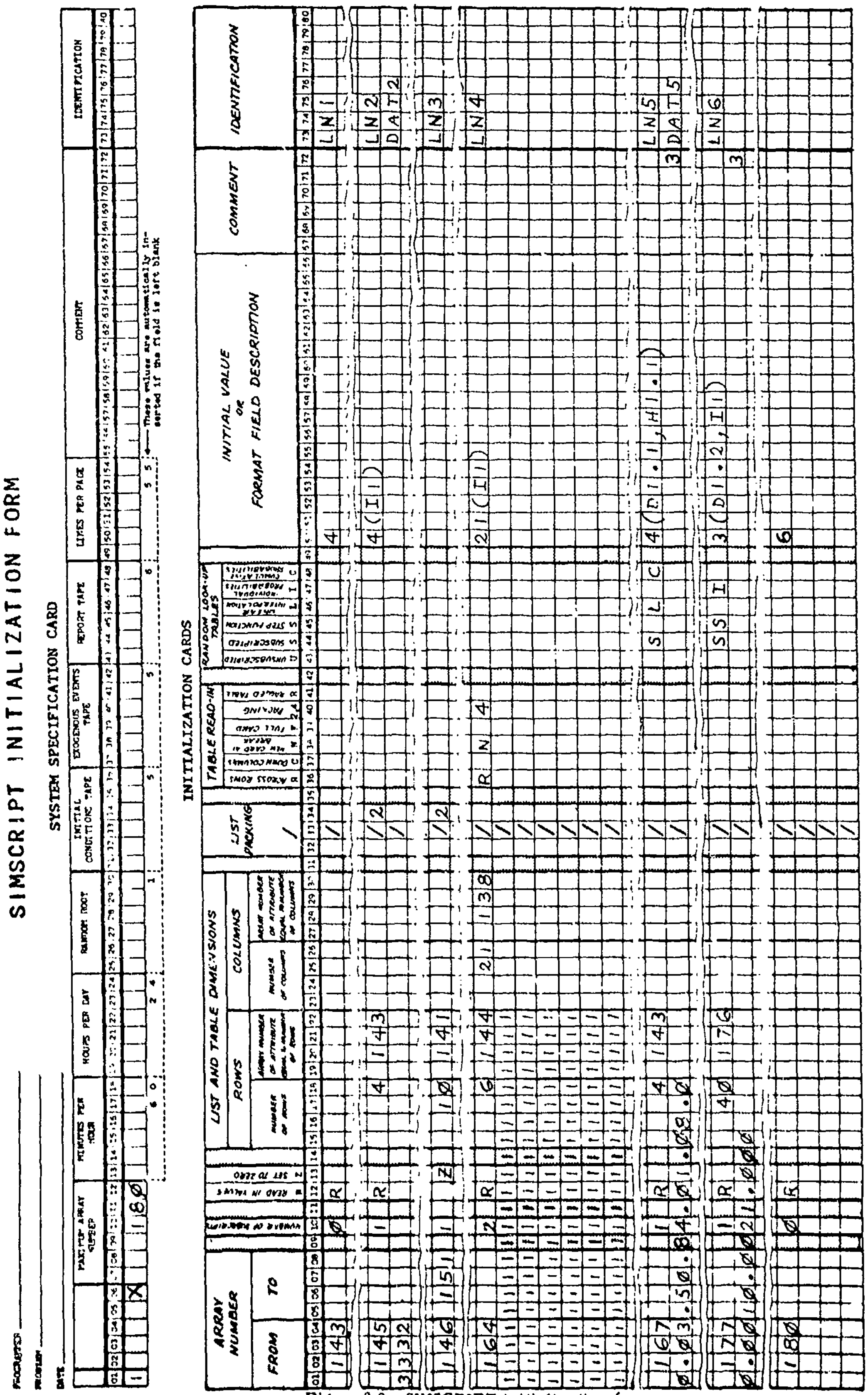


Figure 3-3. SIMSCRIPT initialization form.

3-6. Single-Subscripted Permanent Attributes. a. If the intial values are to be read in, a separate initialization card followed by data cards is required for each list of single-subscripted permanent attributes.

b. Figure 3-3, LN2, is an example of the entries required to read in the initial value of a single-subscripted system attribute.

Cols 1-4	Array Number. Enter the array number of the attribute to be initialized.
Col 10	Number of Subscripts. Enter "1" to specify a single-subscripted array.
Col 12	Read-in Values. Enter an "R" to specify that initial values are to be read in.
Cols 15-18	Number of Rows. Enter the maximum subscript value.
Cols 19-22	Enter the array number of the entity that the attribute list describes. The value of the entity must have been previously read in from an initialization card or data card. This value must be the same as that of the largest subscript specified in columns 15-18 above. (Note: in the example in figure 3-3, the number "4" entered in column 50 of LN1 is also entered in column 18 of LN2.)
Cols 33-34	If fractional word packing is specified on the Definition Form (column 44), enter the same packing code in columns 33 and 34.
Cols 50-66	Format Field Description. Enter a Format statement Field Description inclosed in parentheses and preceded by a constant. This field description tells how the intial values appear in the subsequent data card (DAT2).

c. One or more lists of single-subscripted permanent attributes describing the same entity, having consecutive array numbers and the same packing codes, can be initially set equal to zero by the initialization card entries shown in figure 3-3, LN3.

Cols 1-4	Enter the lowest array number of the sequence to be initialized to zero.
Cols 5-8	Enter the highest array number.
Col 10	Number of Subscripts. Enter "1" to specify single-subscripted arrays.
Col 13	Set to zero. Enter "Z" to specify that initial values will be set to zeros.
Cols 15-18	Number of Rows. Enter the largest value the subscript is to take on.
Cols 19-22	Enter the array number of the entity that the attribute list describes.

Cols 33-34 Enter the packing code specified on the Definition Form (column 44). Packing must be indicated when single-subscripted attribute is initialized to zero. If more than one array is to be initialized to zero, the packing code of the arrays must be the same.

3-7. Double-Subscripted Permanent Attributes. a. If nonzero initial values are to be read in for a table of double-subscripted permanent attributes, each table requires a separate initialization card followed by data cards containing the values.

b. Figure 3-3, LN4, is an example of the entries required to read in the initial values of a table of double-subscripted permanent attribute.

Cols 1-4 Array Number. Enter the array number of the attribute table.

Col 10 Number of Subscripts. Enter "2" for a double-subscripted attribute.

Col 12 Read-in Values. Enter an "R" to specify that initial values are to be read in.

Cols 15-18 Enter the largest value that the row subscript is to take on. (The first subscript of a double-subscripted permanent attribute always designates the row of the table.)

Cols 19-22 Enter the array number of the system variable entity, the value of which is equal to the value of the largest row subscript defined in columns 15-18 above.

Cols 23-26 Enter the largest value that the column subscript is to take on.

Cols 27-30 Enter the array number of the system variable entity, the value of which is equal to the value of the largest column subscript defined in columns 23-26 above.

Col 36 Across Rows. Enter an "R" to indicate that the values of the attribute are to be read across rows (as opposed to down columns in which case a "C" would be entered in column 37).

Col 38 Enter an "N" to indicate that the beginning of each new row is to start on a new data card.

Col 40 Enter a "4" to show that the table entries are to be packed into a fourth of a storage word. (Columns 32-34 of the initilization card are ignored in the case of double-subscripted permanent attributes.)

Cols 50-66 Format Field Description. Enter the Format statement Field Description inclosed in parentheses and preceded by a constant to indicate how the table entries will appear in subsequent data cards.

c. If the initial values of a double-subscripted permanent attribute are to be set to zero, the following entries are required:

Cols 1-4	Array Number. Enter the array number of the attribute table.
Col 10	Number of Subscripts. Enter "2" for a double-subscripted attribute.
Col 13	Enter "Z" to specify that initial value is to be set to zero.
Cols 15-18	Enter the largest value that the row subscript is to take on.
Cols 19-22	Enter the array number of the system variable entity, the value of which is equal to the value of the largest row subscript defined in columns 15-18 above.
Cols 23-26	Enter the largest value that the column subscript is to take on.
Cols 27-30	Enter the array number of the system variable entity, the value of which is equal to the value of the largest column subscript defined in columns 23-26 above.

3-8. Random Look-up Tables for Subscripted Attributes. a. Single-subscripted permanent attributes may have their values determined by either of two random look-up procedures. A linear interpolation procedure is provided for linear approximations to continuous distributions; a step function procedure is provided for discrete probability distributions.

b. Figure 3-3, LN5, is an example of the entries required to read in the values for a series of points describing the continuous cumulative probability curve. The cumulative probability curve may be described by as many points as desired. Single-subscripted random attributes require a series of look-up tables, one for each value the subscript can take on.

Cols 1-4	Array Number. Enter the array number of the random look-up table.
Col 10	Number of Subscripts. Enter "1" for a single-subscripted table.
Col 12	Read-in Values. Enter an "R" to specify that initial values are to be read in.
Cols 15-18	Number of rows. Enter the maximum subscript value.
Cols 19-22	Enter the array number of the system attribute entity, the value of which is equal to the maximum subscript value defined in columns 15-18 above.
Col 44	Enter an "S" to indicate a subscripted table.
Col 46	Enter an "L" to specify that linear interpolation will be used to determine the attribute value.
Col 48	Enter a "C" to show that the look-up table will be read-in in terms of cumulative probabilities. The cumulative probability of the first possible attribute value must be equal to 0.0; that of the last possible value should be 1.0 (see DAT5).

Cols 50-66 Format Field Description. Enter a pair of Field Descriptions inclosed in parentheses and preceded by a constant. These Field Descriptions tell how the initial values appear in subsequent data cards. Each row entry in the look-up table must begin on a new data card. Column 72 of the data card indicates the number of paired entries (i.e., the number of pairs of probability and value combinations) contained in the card. (See figure 3-3, DAT5.)

c. Figure 3-3, LN6, is an example of the entries required to read-in the values of a look-up table describing a discrete probability distribution.

Cols 1-4 Array Numbers. Enter the array number of the random look-up table.

Col 10 Number of Subscripts. Enter "1" for a single-subscripted table.

Cols 15-18 Number of rows. Enter the maximum subscript value.

Cols 19-22 Enter the array number of the system attribute entity, the value of which is equal to the maximum subscript value defined in columns 15-18 above.

Col 44 Enter an "S" to indicate a subscript table.

Col 45 Enter an "S" to identify a step function

Col 47 Enter an "I" to indicate that the values will be read in as individual probabilities. The individual probabilities are accumulated in the order of their appearance in the Initial Conditions Deck.

Cols 50-66 Format Field Description. Enter a pair of Field Descriptions inclosed in parentheses and preceded by a constant. These Field Descriptions tell how the initial values appear in subsequent data cards. Each row entry in the look-up table must begin on a new data card. Column 72 of the data card indicates the number of paired entries (i.e., the number of pairs of probability and value combinations) contained in the card. (See figure 3-3, DAT6.)

d. Chapter 4 contains a description of all the permanent system variables contained in the Depot Transportation Simulator and instructions on how they are to be initialized. A blank card separates the Initial Conditions and the Exogenous Events Decks.

3-9. Exogenous Events. a. Each kind of event included in the simulator may occur repeatedly or at any desired point in simulated time. When the execution of a particular event routine is finished, simulated time is immediately advanced to the time of the next most imminent event, whether it be seconds, hours, or days away, and the appropriate event routine is automatically called and executed. The intervening time periods, when no status changes occur, are skipped.

b. The SIMSCRIPT timing routine permits the occurrence of both endogenous and exogenous events. Endogenous events are caused by previous events within the simulation.

For example, when cargo carrier goes into scheduled maintenance, the carrier is "scheduled" to become available when the maintenance is completed.

c. Exogenous events are introduced from outside the simulation by means of an Exogenous Events Deck. For example, if it were desirable to increase the number of transport vehicles after several simulated months of operation, an exogenous event record may be read-in at the appropriate time to indicate the quantity being generated (see Exogenous Event CRGEN in chapter 4). One caution should be exercised in initializing the exogenous events. Exogenous events must be ordered on time, beginning at time 0 and progressing through to end of simulation.

d. Five exogenous events are used in the Depot Transportation Simulator. A description of each of the events and their data requirements are contained in chapter 4. Once the Data Deck has been assembled, it can be added to the source program, thus completing the SIMSCRIPT simulation job. After execution by the computer, an output tape is obtained. The output tape contains records of the variables listed in appendix F that have changed through simulated time. This output tape is then used as input for the UTIL, CARGO, or LIST output program. For the appropriate report program and the operating instructions, see chapters 5, 6, and 7.

CHAPTER 4

SIMULATOR INPUT DATA ORGANIZATION

4-1. General. This chapter describes the input requirements for the Depot Transportation Simulator. Sample forms are presented that may be used to help translate real-world data into an operating SIMSCRIPT program.

4-2. Performing a Simulation Analysis. To perform a simulation analysis, one must represent the system under study, or a portion of it, in some abstract form. Such a representation, or model of the system, may be simple or complex, depending upon a number of factors. Foremost is the question of how much is known about the system in terms of the interactions between and among its elements; next, there is the question of which interactions the system analyst wishes to measure to predict expected behavior.

4-3. Simulating a Transportation System. In simulating a transportation system, for example, the computer is given the physical configuration of the system, the expected cargo to be moved, the capacity and velocity of the cargo carriers, the scheduled stops the carriers are to make, the locations of the stops, etc. With this information, the computer will move the cargo through the system as specified by the input data. If enough carriers of the right size have been provided, requirements for carriers will be met and queues will not form. During the course of simulated time, the computer keeps track of how well the system performs according to such measures as cargo tons delivered, number of units delivered to each installation, carrier mileage, and availability and queue times.

4-4. Evaluating the Simulated System. With these data, the manager can evaluate a system and hypothesize alternative procedures that could be invoked by managerial personnel. For example, he can determine the required cargo carrying capacity and priority for the various transportation vehicles in the system; priority of various classes of cargo (i.e., special or cycle); frequency and, to some extent, the schedule of pickups and deliveries to the installations. In effect, the simulation, based on limited information, can probe system behavior only in a gross way. Even so, it can be extremely useful in establishing guidelines for planners during the life of a program when equipment configuration and procurement are being negotiated; when personnel training is being considered; when delivery schedules are being established; and when specification and operating improvements are being proposed.

4-5. Specifying Problem Parameters. The first task confronting the manager in running a simulation is specifying the parameters of the problem to be simulated. Tables 4-1 through 4-7 are sample forms that may be used to organize the data required to initialize the SIMSCRIPT program.

4-6. Installation Locations. a. In specifying the transportation network, the user must first determine the number of installations to be considered and their locations. An installation is defined as any location that owns cargo carriers, or any location where cargo is to be picked up or delivered. Figure 4-1 is a map of the United States showing the ten installations used in this example. The number of installations and the level of detail used in the simulation are left to the discretion of the user. The major constraint is the capacity of the computer memory. We have structured the example primarily to demonstrate the utility of the simulator and to show how data are to be initialized.

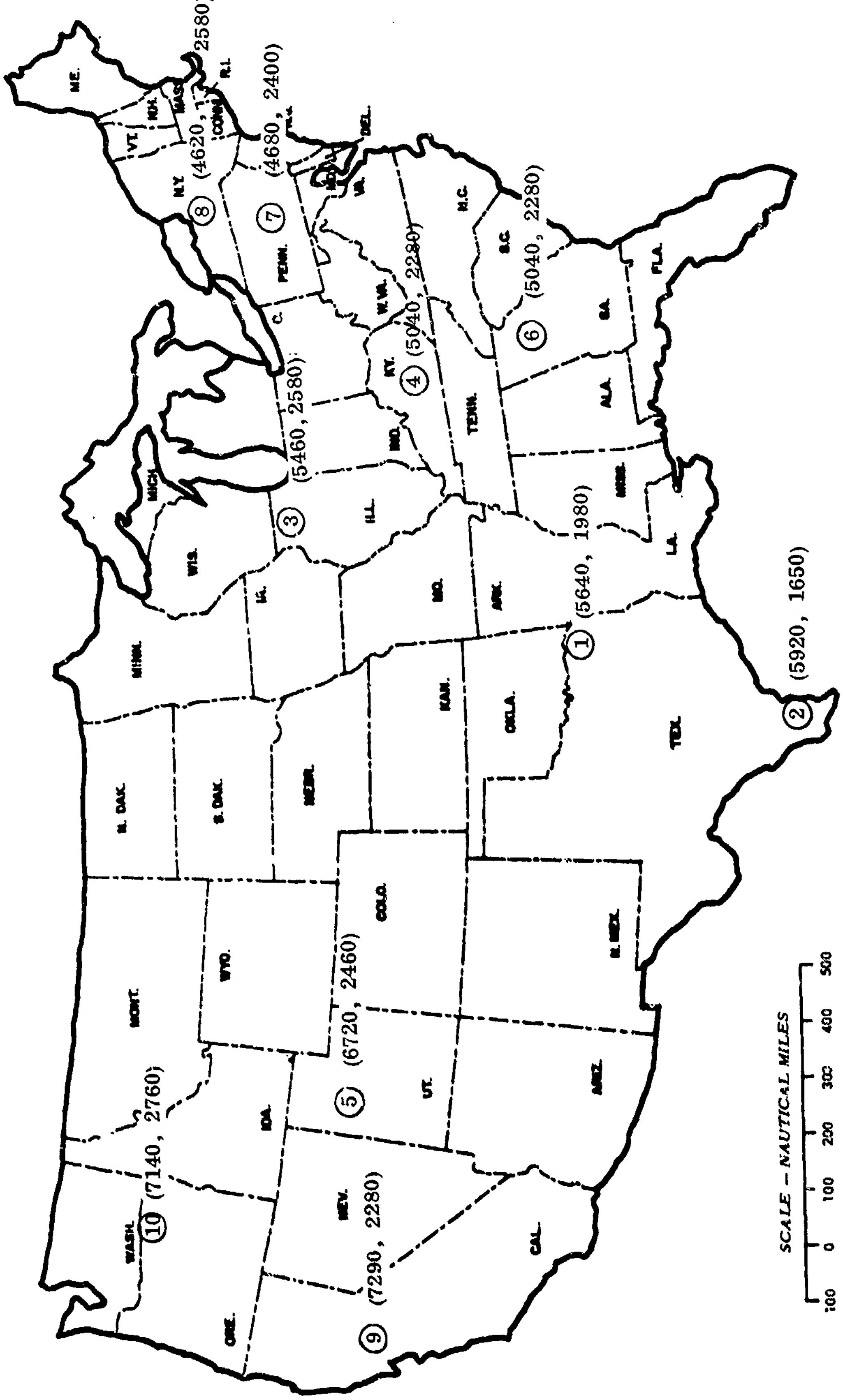


Figure 4-1. Installation locations.

b. Each installation is located according to some Cartesian coordinate system. The system chosen is immaterial, provided the velocity of the cargo carriers (to be specified later) is expressed in compatible terms. The system chosen for the example is longitude and latitude, in minutes. One minute at the equator is equal to one nautical mile; but since all the installations are in the zone of interior, for convenience, in this example we will consider one minute as equal to one statute mile.

4-7. System Operations. a. The first step in defining the system's operating characteristics is to specify when the carriers will operate. For example, if the simulator is to be used to examine the airdrop capability of a given fleet of aircraft, the system may operate only during daylight hours. Or, if it is used to simulate the delivery capability of a number of supply trucks, the system may operate 24 hours a day, 7 days a week. The same might apply to "special" airlift supply and resupply problems, such as occurred during the Cuban crisis in 1961 and 1962.

b. The simulator assumes a 24-hour day (from 0000 to 2400 hours) and a seven-day week. An interval change will occur at N hours (N is a system variable). If N = 8 hours, there will be three intervals — from 0000 to 0800, 0800 to 1600, and 1600 to 2400. Various intervals may be used provided the day is divided into equal parts.

Table 4-1

SYSTEM OPERATIONS

(1) (2) (3) OPERATING INTERVALS			(4) ADMINISTRATIVE DELAY TIME DISTR.			(5) UPLOAD TIME DISTRIBUTION			(6) OFFLOAD TIME DISTRIBUTION		
LENGTH	NO. PER DAY	NO. PER WEEK	MIN	B	MAX	MIN	B	MAX	MIN	B	MAX
8.0 HR	3	21	0.2 HR	0.5/0.8	1.0 HR	1.0 HR	2.0/0.7	4.0 HR	1.0 HR	2.0/0.7	4.0 HR

(1) The value can be entered in table 4-1, column 1.

(2) Column 2 lists the operating intervals during the day.

(3) Column 3 lists the number of intervals per week.

(4) Column 4 is an administrative delay time distribution that will delay the beginning of an event, such as uploading, offloading, etc.

(5) Column 5 lists the cargo upload time distribution at the installations. (The actual processing time will be drawn from the distribution.)

(6) Column 6 is the cargo offload time distribution at the installations. (The additions under subcolumns B are hrs/cumulative probability.)

c. The shape and number of points on the distribution curve are left to the discretion of the user. The minimum and maximum values bound the distribution. B represents the points, if any, between the bounds. It can be a single value, as shown in the example, or it can be any number of points desired. More columns can be added if necessary. The distribution data will be read in at initialization as a cumulative probability, i.e., the probability will always begin with 0.0 and end with 1.0. Thus the probabilities associated with the minimum and maximum values are taken automatically to be 0.0 and 1.0, respectively; therefore, these probabilities are not recorded in the example data. The B column, however, requires both a time and a probability. Since this probability (or probabilities) can be any value, both values must be specified. Interpolation between points of the distribution will be linear. Although only a three-point distribution is used in the example data, the number of points describing the curve is at the discretion of the user.

4-8. Delay or Loss. a. After a cargo carrier leaves an installation, there is some probability that it will be delayed or destroyed before it reaches its next destination. Delays may result from detours, bad weather, minor accidents, breakdowns, etc. Losses may result from mechanical failure, enemy action, accidents, etc. If a loss occurs, any resources in the carrier are also lost and will be deleted from the simulation along with the carrier.

b. Table 4-2 lists the individual probabilities of no delay, delay, or loss for each installation and for each carrier type. Since there are ten installations in the example data and four carrier types, the installation numbers are repeated four times (one for each carrier type in sequence). At the top of the table is the time distribution for the delay, if one should occur. A precautionary note is in order: unlike cumulative probabilities (such as the delay time distribution, which must begin with an 0.0 probability and end with 1.0), individual probabilities for the installation/carrier used in this table must sum to 1.0.

4-9. Cargo Definition. Table 4-3 lists the cargo to be moved through the system.

a. Column 1 lists the cargo identification number, used by the computer program to describe the cargo; the analyst can also list the name, part number, or stock number for this purpose.

b. Column 2 lists the units' shipping volume and weight.

c. Column 3 lists the shipping conditions for each piece of cargo; there are three conditions.

(1) Condition 1 refers to cargo that will require a special run (not a special carrier), e.g., hazardous or very expensive cargo.

(2) Condition 2 refers to cargo that will require a special carrier, such as a missile and space booster transporter, a specially modified aircraft, etc.

(3) Condition 3 refers to cargo that requires no special handling; it can be mixed, carried on normally scheduled trips, and the like. (In the example data, notice that cargo items 4, 5, and 6 are outsized (high volume, low density) and will require a special carrier of type 4. Carrier types and quantities are discussed in chapter 6 in connection with table 4-4. Cargo items 7, 8, and 9 will require special runs. An available carrier will be dispatched from the destination to pickup and deliver these items of cargo. The remaining items will move via the "normal" transportation network.)

Table 4-2

DELAY OR LOSS EN ROUTE

Cumulative probability of delay:

min — 0.2 hrs

B — 0.4 hrs/0.5 (hrs/cum prob)

max — 0.8 hrs

Installation No.	Probability of: No Delay Code = 0	Delay Code = 1	Loss Code = 2
Carrier Type 1			
1	1.0	0.0	0.0
2	0.0	1.0	0.0
3	1.0	0.0	0.0
4	0.0	0.0	1.0
5	1.0	0.0	0.0
6	0.0	1.0	0.0
7	1.0	0.0	0.0
8	0.0	0.0	0.0
9	1.0	0.0	0.0
10	0.0	1.0	0.0
Carrier Type 2			
1	1.0	0.0	0.0
2	1.0	0.0	0.0
3	1.0	0.0	0.0
4	1.0	0.0	0.0
5	1.0	0.0	0.0
6	0.0	1.0	0.0
7	0.0	1.0	0.0
8	0.0	1.0	0.0
9	0.0	1.0	0.0
10	0.0	1.0	0.0

Installation No.	Probability of: No Delay Code = 0	Delay Code = 1	Loss Code = 2
Carrier Type 3			
1	0.2	0.4	0.4
2	0.1	0.2	0.7
3	0.3	0.3	0.4
4	0.4	0.4	0.2
5	0.5	0.5	0.0
6	1.0	0.0	0.0
7	1.0	0.0	0.0
8	1.0	0.0	0.0
9	1.0	0.0	0.0
10	1.0	0.0	0.0
Carrier Type 4			
1	0.0	1.0	0.0
2	0.0	1.0	0.0
3	0.0	1.0	0.0
4	0.0	1.0	0.0
5	0.0	1.0	0.0
6	0.1	0.2	0.7
7	0.7	0.3	0.0
8	0.8	0.1	0.1
9	0.9	0.1	0.0
10	0.9	0.0	0.1

Table 4-3

CARGO DEFINITION

(1) Cargo ID No.	(2) Size		(3) Transportation Condition	(4) Terminal Installation Number	(5) Terminal Installation Delay Time Distribution (days)		
	Vol	Weight			Min	B (Hrs/cum prob)	Max
1	110	11,386	3	7	1	2/0.6	5
2	110	10,386	3	8	2	3/0.7	5
3	70	8,386	3	9	4	6/0.5	8
4	370	7,768	2	10	2	3/0.8	6
5	370	8,768	2	1	2	8/0.7	10
6	370	9,768	2	2	5	10/0.6	11
7	140	7,573	1	5	10	15/0.7	20
8	140	8,573	1	7	12	18/0.5	20
9	140	9,573	1	8	11	16/0.6	20
10	100	14,449	3	9	10	15/0.8	18
11	180	14,449	3	10	10		18
12	10	200	3	1	3	4/0.4 6/0.8	9
13	10	200	3	2	3		9
14	110	14,685	3	5	2	3/0.8 4/0.9	5
15	40	10,462	3	7	2	4/0.6	10
16	90	10,462	3	8	1		4
17	40	10,462	3	1	1	3/0.9	20

d. Column 4 lists the destination of each item of cargo. A delay is introduced at this destination to represent any processing time that may be required before the cargo is returned to its origin.

e. Column 5 lists the delay time distribution.

4-10. Cargo Carrier Definition. The next step is to specify the characteristics of each cargo vehicle type. Table 4-4 lists the data required for the simulation.

a. Column 1 lists the carrier ID number and the description of the carrier, if desired.

b. Column 2 lists the quantity of each carrier type. The quantity represented here is the total quantity of each available in the system. The assignment of each carrier to a home installation will be done later with exogenous event CRGEN.

c. Column 3 lists the travel code for each carrier. There are three codes — 1 is assigned to a special carrier, 2 is for carriers that will make special runs, and 3 is for cyclic (normal) runs.

d. Column 4 lists the cargo carrying capacity of each type of carrier in terms of volume and weight. It should be pointed out here that special carriers, such as carrier 4

Table 4-4

CARGO CARRIER DEFINITION

(1)	(2)	(3)	(4)		(5)			(6)						(7)
			Cargo Capacity		Velocity			Maintenance Time Distribution						
								Minor			Major			
ID No. & Description	Qty	Travel Code	Vol	Weight	Min	B	Max	Min	B	Max	Min	B	Max	Distance Between Major Maint Actions
1	7	3	150	25,000	475	550/0.8	600	0.5	1.0/0.8	1.0	3.5	4.0/0.8	8.0	15,000
2	7	3	325	25,000	475	550/0.9	600	0.5	1.0/0.8	1.0	3.5	4.0/0.8	8.0	10,000
3	3	2	400	40,000	230	250/0.8	300	0.5	1.0/0.7	1.5	4.0	6.0/0.9	8.0	20,000
4	3	1	400	10,000	250	300/0.5	400	1.0	2.0/0.5	2.5	2.0	4.0/0.5	5.0	6,000

in the example data, are not necessarily limited to transporting special cargo (Cargo ID No. 4, 5, and 6). If specified in the initialization data (table 4-7, array 157), special carriers may pick up and discharge additional cargo,if capacity is available during the special trip. For example, if some outsized cargo is generated at some installation and a special carrier is required, and there is some cargo to be delivered to that installation when the special carrier leaves its home installation, then the special carrier will deliver the assigned cargo even though the cargo would normally be delivered on a scheduled run. Similarly, on the return trip, if there are some small pieces of cargo that will fit and have the same destination, it will be loaded and delivered along with any special cargo.

e. Column 5 lists the cargo carriers in-transit velocity distributions. Velocity may be defined in any term so long as it is consistent with the installation location coordinate system (figure 4-1). The velocity distribution is a cumulative probability; therefore, if more than the minimum and maximum values are used (i.e., a multipoint distribution), a probability, as well as the time, must be listed for B.

f. Column 6 lists the two maintenance time distributions — minor and major — for each carrier type. Minor maintenance represents the servicing actions performed on the carrier at each stop, e.g., fueling, servicing, etc. Major maintenance represents repairs, overhauls, replacement of parts, etc., and is performed periodically at the home installation.

g. Column 7 lists the distance between major maintenance actions. After a cargo carrier has traveled the distance specified, the time in maintenance will be drawn from the cumulative distribution specified in column 5.

4-11. Trip Schedule. Trip schedules are required for cyclic runs only. Special runs and trips requiring special carriers are dispatched on an "as needed" basis. Table 4-5 presents an example of the information needed for the Depot Transportation Simulator.

a. Column 1 lists the carrier type required for this trip.

b. Column 2 lists a trip number (up to four digits) for the convenience of the analyst.

c. Column 3 lists for each trip the interval at which the round trip is to be repeated. For example, trip number 1 uses carrier type 1 and the round trip is repeated every 3 days. Trip number 2 uses carrier type 2 and makes one round trip daily.

d. Column 4 lists the origin installation of each leg of the trip. The first entry will be used to specify the home installation for each carrier. All carriers will leave from their home installation and eventually return to their home installation.

e. Column 5 lists the depart time of the day from the originating installation. Departure time may be scheduled as in the example data, or the departure from each installation may be on an "as ready" basis; i.e., as soon as the carrier is serviced and loaded, it will depart for its next destination, listed in column 6.

4-12. Cargo Availability Schedule. a. Table 4-6 lists the cargo that is to be available for shipment during the simulation. The items of cargo to be shipped will be generated by the simulator according to this schedule. Thus, column 1 is time-oriented, starting with time 0 and progressing through to the "end of simulation."

Table 4-5

TRIP SCHEDULE

(1) Carrier Type	(2) Trip No.	(3) Cycle Interval (days)	(4) Origin Installation	(5) Depart Time Day	(5) Depart Time Hour	(6) Destination Installation
1	1	3.00	1	0	2200	5
			5	1	0055	10
			10	1	0405	9
			9	1	0705	2
			2	1	1205	1
2	2	1.00	1	0	2340	2
			2	1	0535	1
1	3	7.00	8	1	0850	7
			7	1	1105	3
			3	1	1355	1
			1	1	1815	5
			5	2	0030	10
			10	2	0440	8
1	4	3.00	8	1	1630	3
			3	1	2015	5
			5	2	0355	10
			10	2	0815	8
1	5	1.00	9	1	2245	10
			10	2	0145	5
			5	2	0455	2
			2	2	1005	9
1	6	1.00	5	2	1600	1
			1	2	2100	3
			3	3	0120	7
			7	3	0410	8
			8	3	0725	5
2	7	2.00	5	3	0800	1
			1	3	1300	3
			3	3	1720	8
			8	3	2135	5
1	8	1.00	1	4	0200	3
			3	4	0620	7
			7	4	0910	6
			6	4	1250	4
			4	4	1530	1

Table 4-5 -- continued

(1) Carrier Type	(2) Trip No.	(3) Cycle Interval (days)	(4) Origin Installation	(5) Depart Time		(6) Destination Installation
				Day	Hour	
1	9	1.00	2	4	1200	4
			4	4	1540	6
			6	4	1805	7
			7	4	2145	3
			3	5	0035	2
1	10	1.00	1	4	2000	4
			4	5	0010	6
			6	5	0235	7
			7	5	0715	1
2	11	2.00	10	4	2030	1
			1	5	0330	6
			6	5	0815	1
			1	5	1100	10
1	12	1.00	9	4	2120	5
			5	5	0100	3
			3	5	0830	7
			7	5	1100	9
3	13	3.00	7	5	2020	6
			6	6	0000	4
			4	6	0240	2
			2	6	0620	9
			9	6	1120	7

Table 4-6

CARGO AVAILABILITY SCHEDULE

(1) Time			(2)	(3)	(4)	(5)
Day	Hr	Min	Cargo ID No.	Qty	Origin Installation	Destination
0	03	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	3	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1
1	12	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	7	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1
2	00	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	7	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1
3	10	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	7	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1
5	12	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	7	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1
8	15	00	1	3	5	7
			2	2	6	8
			3	2	7	9
			4	1	5	10
			5	1	2	1
			6	1	3	2
			7	1	7	5
			8	1	6	7
			9	1	4	8
			10	5	8	9
			11	3	2	10
			12	10	3	1
			13	20	7	2
			14	4	9	5
			15	6	10	7
			16	3	4	8
			17	5	6	1

b. Column 2 lists the cargo items that are being made available at the time specified in column 1.

c. Column 3 lists the quantity of each item of cargo available for shipment.

d. Column 4 specifies the installation where the cargo is generated.

e. Column 5 lists the cargo's destination. Only the source and destination are specified for the item of cargo. The cargo will be returned to the origin installation later, after it has been processed through the terminal installation delay time specified in table 4-3, column 5.

4-13. Simulator Initialization. Table 4-7, Variable Description and Initialization, describes in sequence the permanent system variables in the Depot Transportation Simulator and specifies how they are to be initialized. The formats used to initialize the different types of variables (e.g., unsubscripted, single-subscripted, and double-subscripted) have been described in chapter 3. Using these formats and the data in table 4-7, the SIMSCRIPT Initialization Form can now be completed.

4-14. Simulator Exogenous Events. Five exogenous events are used in the Depot Transportation Simulator. Description of each of the events and the data requirements follow.

a. DSTART (Start Simulation Run). This event establishes the simulated time at the beginning of a simulation run. Normally, the start time will be initialized to zeros. If simulated start time other than zero is used, care must be taken that following events occur at time greater than start time.

DSTART Event Card Format.

Cols 1-3	Event type 016, defines the event DSTART.
Cols 4-7	Day of event.
Cols 8-10	Hour of day.
Cols 11-12	Minute of hour.

b. CRGEN (Carrier Generation). This event generates carriers for the transportation network. Carriers may be generated at any time during the simulation run. For instance, the user may generate all carriers at the beginning of the simulation (as in the example run) or he may wish to examine the impact of an increased number of carriers of some particular type at some of the installations. In that case, CRGEN event cards would be read in to generate additional carriers at the desired time in the simulation run.

(1) CRGEN Event Card Format.

Cols 1-3	Event type 018, defines the event CRGEN.
Cols 4-7	Day of event.
Cols 8-10	Hour of day.

TABLE 4-7
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
1-137	0			Z							Reserved for other Simulators.			
138	0	I			V	4-1	3				Number of intervals per week.	SPDE		A
139	0	I			V	4-1	2				Intervals per day.	SPDAE		A
140	0		F		V	4-1	1				Interval duration.	SENT		A
141	0	I			V	(Fig.	4-1)				Number of Installations to be serviced.	BASE	E	
142	0	I			V	4-3	1				Number of resource types.	PARTS	E	
143	0	I			V	4-4	1				Number of carrier types.	CARS	E	
144	0	I			V						Programmed data. Max. No. of programmed events. Initialize to 6.	MXEVT	E	
145	1	I			V	4-4	3	143		2	Travel code for each carrier: 1 = Special carrier. 2 = Special run. 3 = Cyclic.	TRCOD		A
146	1	I		Z				141		2	First in travel Q cycle run.	FTRPQ		A
147	1	I		Z				141			First in special run Q.	FSPRQ		A
148	1	I		Z				141		2	First in special carrier Q.	FSPCQ		A
149	1	I		Z				141		2	Last in cyclic run travel Q	LTRPQ		A
150	1	I		Z				141		2	Last in special run Q.	LSPRQ		A
151	1	I		Z				141		2	Last in special carrier Q.	LSPCQ		A
152	1	I			V	4-3	2	142		2	Weight of each resource type.	PWT		A
153	1	I			V	4-3	2	142		2	Volume of each resource type.	PVOL		A
154	1	I			V	4-4	3	143		2	Specification of special carrier. 0 = No special carrier, or N = Where N is the special carrier ID number.	SPCAR		A
155	1	I			V	4-4	4	143			Volume of each carrier.	KVOL		A
156	1	I			V	4-4	4	143			Load capacity (weight) of each carrier.	KWT		A
157	0	I			V						Load switch – specify if other cargo can be shipped with each special run. 0 = No other cargo. 1 = Other cargo can accompany special run.	LDSWT	E	
158	0		F		V	4-1	5				Upload time distribution.	TUPLD		A
159	1		F		V	4-4	5	143			Carrier velocity.	CRVEL		A
160	0		F		V	4-1	6				Offload time distribution.	TDNLD		A
161	0		F		V	4-1	4				Administrative delay time.	ADMDL		A
162	1		F		V	4-3	5	142			Terminal point delay time.	DRTIM		A
163	0	I		Z							Current interval of week at start of simulation.	SPD		A
164	2	I			V		[illegible]	144	138	4	Event availability – specify intervals during which carriers will operate. 0 = No. 1 = Yes.	EVAVL		A

TABLE 4-7 CONTINUED
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
165	1		F		V	4-4	7	143			Carrier distance permitted between major maintenance actions.	MNTDS		A
166	1		F		V	4-4	6	143			Minor maintenance time distribution.	MINMT		A
167	1		F		V	4-4	6	143			Major maintenance time distribution.	MAJMT		A
168	1	I			V	(Fig.	4-1)	141		2	Installation locations (X coordinates).	XLOC		A
169	1	I			V	(Fig.	4-1)	141		2	Installation locations (Y coordinates).	YLOC		A
170	1	I		Z				141		2	First in event Q.	FEVQ		A
171	1	I		Z				141		2	Last in event Q.	LEVQ		A
172	1	I		Z				141		2	First in carrier Q.	FCAVQ		A
173	1	I		Z				141		2	Last in carrier Q.	LCAVQ		A
174	0	I		Z							Current interval.	SWIFT		A
175	0	I		Z							Time of shift change.	TTCHS		A
176	0	I			V						Program data. Initialize to (No. installations X carrier types).	FORTY	E	
177	1	I	F		V	4-2		176			In sequence for each carrier type list the individual probability of no delay, delay, and loss with codes: 0 = No delay. 1 = Delay. 2 = Loss.	PLOD		A
178	0		F		V	4-2					Delay time distribution between installations.	CRDL		A
179	1	I			V	4-3	3	142		2	Resource transport conditions.	ICOD		A
180	0	I			V						Program data. Initialize to assigned output number.	TPOUT		A

Cols 11-12	Minute of hour.
Cols 13-15	Number of data cards to follow.

(2) CRGEN Event Data Card Format.

Cols 1-2	Installation number where carrier is to be located.
Cols 3-4	Carrier type number (table 4-4, column 1).
Cols 5-6	Quantity to be generated (table 4-4, column 2).

c. CYGEN (Generate Cycle Runs). This event generates the cyclic runs listed in the Trip Schedule (table 4-5).

(1) CYGEN Event Card Format.

Cols 1-3	Event type 017, defines the event CYGEN.
Cols 4-7	Day of event (table 4-4, column 5).
Cols 8-10	Hour of day.
Cols 11-12	Minute of hour.
Cols 13-14	Origin installation (table 4-4, column 4).
Cols 15-16	Carrier type number (table 4-4, column 1).
Cols 17-18	Number of stops carrier will make this trip (table 4-4, column 6).
Cols 19-20	Trip number (table 4-4, column 2).
Cols 21-26	Recycle interval (table 4-4, column 3, use Format D2.3).

(2) CYGEN Event Data Card Format (one data card required per stop).

Cols 1-2	Installation number of stop (table 4-5, column 4).
Cols 3-8	Time of departure from installation (table 4-5, column 5, use Format D2.3).

d. TRANZ (Generate Cargo for Shipment). This event makes the cargo available for shipment from installation to installation (table 4-6).

TRANZ Event Card Format.

Cols 1-3	Event type 019, defines the event TRANZ.
Cols 4-7	Day of event (table 4-6, column 1).

Cols 8-10 Hour of day (table 4-6, column 1).

Cols 11-12 Minute of hour (table 4-6, column 1).

Cols 13-14 Cargo ID number (table 4-6, Column 2).

Cols 15-19 Leave blank.

Col 20 Specify if cargo is to be sent to depot for overhaul (code = 0) or repair (code = 1).

Cols 21-22 Origin installation number (table 4-6, column 4).

Cols 23-24 Destination installation number (table 4-6, column 5).

Cols 25-28 Quantity to be generated (table 4-6, column 3).

e. ENDSIM (End of Simulation). This event specifies when the simulation run is to end.

ENDSIM Event Card Format.

Cols 1-3 Event type 004, defines the event ENDSIM.

Cols 4-7 Day of event.

Cols 8-10 Hour of day.

Cols 11-12 Minute of hour.

CHAPTER 5

LIST OUTPUT PROGRAM

5-1. General. The LIST output program prints all or selected transaction codes from the depot transportation simulator output tape. Appendix C is an example of the data record listing produced by the LIST program.

5-2. Initialization. The LIST output program requires the user to initialize 33 variables. Table 5-1, Variable Description and Initialization: LIST, describes the variables and specifies how they are to be initialized.

5-3. LIST Output Program Overview. a. The input to the LIST program is the tape generated by the depot transportation simulator. This input tape consists of twelve-word records and is read from logical unit IDAT. Appendix F contains the format of the tape records.

b. The user has the following options:

(1) Print all transaction codes.

(2) Print all transaction codes between START and STOP.

(3) Print transaction codes pertinent to selected installations (BASE).

(4) Print selected transaction codes as specified in SEL.

(5) Print any combinations of (2), (3), and (4) above (e.g., transaction codes 5010, for installation (BASE) number 1, occurring during simulated days 1 through 10).

TABLE 5-1
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-5 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
1	0	I		Z							Internal variable.	IDSOR		A
2	0	I		Z							Internal variable.	IDSUB		A
3	0	I		Z							Internal variable.	SHFT		A
4	0	I		Z							Internal variable.	DAYW		A
5	0	I		Z							Internal variable.	SXDW		A
6	0	I		Z							Internal variable.	EBAS		A
7	0	I		Z							Internal variable.	VA		A
8	0	I		Z							Internal variable.	VB		A
9	0	I		Z							Internal variable.	VC		A
10	0	I		Z							Internal variable.	TRSM		A
11	0	I		Z							Internal variable.	MORE		A
12	0		F	Z							Internal variable.	ETIME		A
13	0	I		Z							Internal variable.	DTLV1		A
14	0	I		Z							Internal variable.	DTLV2		A
15	0	I		Z							Internal variable.	DTLV3		A
16	0	I		Z							Internal variable.	DTLV4		A
17	0	I		Z							Internal variable.	DTLV5		A
18	0	I		Z							Internal variable.	DTLV6		A
19	0	I		Z							Internal variable.	DTLV7		A
20	0	I		Z							Internal variable.	DTLV8		A
21	0		F	Z							Internal variable.	DTLV9		A
22	0		F	Z							Internal variable.	DTLV0		A
23	0	I			V						0 = Do not select on Word 2. 1 = Select on Word 2.	LFLAG		A
24	0		F		V						Start listing records at this time.	START		A
25	0		F		V						Stop listing records at this time.	STOP		A
26	0	I			V						No. of IDD's to select. Applicable when LFLAG = 1. (Must be Z1).	SLK	E	
27	1	I			V			26		2	IDD's selected when LFLAG = 1.	SEL		A
28	0	I			V						Number of installations for which data records are to be listed.	BASES	E	
29	1	I			V			28		2	Installation numbers for which data records are to be listed.	BASE		A
30	0	I		Z							Internal variable.	BFLAG		A
31	0	I			V						Data tape number.	IDAT		A
32	0	I			V						Program data. Enter constant 12.	TWELV	E	
33	0		F		V						Page heading. Identification to appear at the top of each page. Format 12(A6).	AL		A

CHAPTER 6

UTILIZATION OUTPUT PROGRAM

6-1. General. The UTIL (utilization) output program describes the cargo carrier utilization for the simulation. UTIL program produces printed and/or graphic output reports. Appendix H is an example of the information contained in these reports.

6-2. Printed Output. For each vehicle, column 3 lists the time the vehicle was available for service, column 4 the time lost due to maintenance, and column 5 the time involved in loading the vehicle. Idle time, listed in column 6, is the report interval time minus the sum of maintenance, loading, and in-transit times. The utilization factor is the sum of maintenance time, loading time, and in-transit time, divided by the total simulated time to date.

6-3. Graphic Output. a. This report displays the summary average vehicle utilization rate to date by vehicle type. The ordinate is the utilization rate. The abscissa represents the simulated time period. The lower and upper boundries of the abscissa are input variables.

$$\text{Average utilization rate to date} = \frac{MT + LT + IT}{TT}$$

where: MT = maintenance time to date

LT = loading time to date

IT = in-transit time to date

TT = total simulated time to date.

b. The example graph shown in appendix H was produced on the S-C 4020 plotter from a plot tape generated by the UTIL program. In the case where this plotter is not readily available, UTIL program can be modified to produce printed output only.

6-4. Initialization. The UTIL output program requires the user to initialize 29 variables. Table 6-1, Variable Description and Utilization: UTIL, describes the variables and specifies how they are to be initialized. Variables marked by an asterisk are used by the plotter routines. In the case where a plotter is not available, these variables should be initialized with dummy data. Also, the plot routines referenced in the UTIL program will have to be replaced with substitute dummy routines.

6-5. UTIL Output Program Overview. a. The input to UTIL program is the tape generated by the depot transportation simulation program. This input tape consists of twelve-word records and is read from logical unit IDAT. Appendix F contains the format of the tape records.

b. At the beginning of the program, the variable OPTNS is tested to determine the type of output to be produced (0 = graphic, 1 = printed, 2 = graphic and printed). Next, a record is read from tape IDAT. The value of GNT is compared with current simulated time

(word 12); if simulated time equals or exceeds the value of GNT, routine to issue a report is executed. Thus, GNT is used to control the report interval. If GNT exceeds the value of simulated time, the current record's information is processed as follows.

c. Word 2 is compared with internal four-digit codes in order to select, for further processing, only records that are relevant to this program. Once such a record is identified, program control is transferred to one of several program routines corresponding to individual four-digit codes.

d. When word 2 is found to equal 3, the end of simulation has been reached. A final report is issued and UTIL terminates.

TABLE 6-1
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZ	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
1	0		F		V						Report interval.	CNT		A
2	0	I			V						Number of cargo carrier types.	CARS	E	
3	1	I		Z				2		2	Internal variable.	FBUSQ		A
4	1	I		Z				2		2	Internal variable.	LBUSQ		A
5	1	I		Z				2		2	Internal variable.	FLSTQ		A
6	1	I		Z				2		2	Internal variable.	LLSTQ		A
7	0	I			V						First vehicle number to be reported – by type.	FVSET		A
8	0	I			V						Last vehicle number to be reported – by type.	LVSET		A
9	1	I						2			Desired sequence of reports or selected vehicle types.	SVSET		A
10	0	I			V						Data tape number.	IDAT		A
11	0	I			V						Type output desired. 0 = graphic – 1 = printed – 2 = printed and graphic	* OPTNS		A
12	0	I		Z							Program data. Initialize to zero.	* POINT		A
13	1		F					2			Value used in plotting the utilization curve.	* TUTL		A
14	0	I									Program data. Initialize to zero.	* PLOTS		A
15	0		F								Lower boundry of the abscissa. Enter time period plotting is to begin.	* XL		A
16	0		F								Upper boundry of the abscissa. Enter time period plotting is to end.	* XR		A
17	0	I			V						Number of vehicles for which graphs are to be produced.	* GRAPH	E	
18	0	I			V						Program data. Initialize to 2.	* TWO	E	
19	0	I			V						Program data. Initialize to 4.	* FOUR	E	
20	0	I			V						Program data. Initialize to 5.	* FIVE	E	
21	0	I			V						Program data. Initialize to 6.	* SIX	E	
22	1	I			V			17		4	Desired sequence of graphic reports – by vehicle.	* VEHI		A
23	1		F		V			17			Vehicle constant. Use alpha format 4(A1).	* VEHA		A
24	1		F		V			21			Constant data used in the identification frame routine by the plotter. Format 6 (A6).	* ADARY		A
25	1		F		V			20			Graph title. Line 1. Format 5 (A6).	* TOPH1		A
26	1		F		V			18			Graph title. Line 2. Format 2 (A6).	* TOPH2		A

TABLE 6-1 CONTINUED
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
27	1		F		V			19			Utilization scale title. Format 4 (A6).	* SIDH		A
28	1		F		V			21			Literal constant to be printed at bottom of each graph.	* BOTLB		A
29	0		F		V						Average utilization rate to date for the report.	* AVGUT		A

CHAPTER 7

CARGO OUTPUT PROGRAM

7-1. General. The CARGO output program displays the quantity of cargo moved through the simulated time period. CARGO program produces printed and/or graphic output reports. Appendix I is an example of the information contained in these reports.

7-2. Printed Output. The quantity of cargo moved is specified in terms of weight, volume, and units for each type of cargo. Note the separate specification of both the quantity of cargo that is loaded aboard some carrier (TP) and the quantity of cargo delivered (TD) by a carrier. The same distinction is made for installation deliveries, column 4, and for the depot, column 5. Column 6 specifies the quantity of each cargo type that is in process (in-transit) as of the report time.

7-3. Graphic Output. This report displays the summary average quantity of cargo onloaded and offloaded at an installation per period of time. A separate curve is plotted for the quantity onloaded and the quantity offloaded.[1] In addition, summarized average totals by units, weight, and volume are printed at the bottom of each graph.

The example graph shown in appendix I was produced on the S-C 4020 plotter from a plot tape generated by the CARGO program. In the case where this plotter is not readily available, CARGO program can be modified to produce printed output only.

7-4. Initialization. The CARGO output program requires the user to initialize 59 variables. Table 7-1, Variable Description and Utilization: CARGO, describes the variables and specifies how they are to be initialized. Variables marked by an asterisk are used by the plotter routines. In the case where a plotter is not available, these variables should be initialized with dummy data. Also, the plot routines referenced in the CARGO program will have to be replaced with substitute dummy routines.

7-5. CARGO Output Program Overview. a. The input to CARGO program is the tape generated by the depot transportation simulation program. This input tape consists of the twelve-word records and is read from logical unit IDAT. Appendix F contains the format of the tape records.

b. At the beginning of the program, the variable OPTNS is tested to determine the type of output to be produced (0 = graphic, 1 = printed, 2 = graphic and printed). Next, a record is read from tape IDAT. The value of GNT is compared with current simulated time (word 12); if simulated time equals or exceeds the value of GNT, routine to issue a report is executed. Thus, GNT is used to control the report interval. If GNT exceeds the value of simulated time, the current record's information is processed as follows.

c. Word 2 is compared with internal four-digit codes in order to select, for further processing, only records that are relevant to this program. Once such a record is

[1]The ordinate is the quantity of cargo onloaded or offloaded at an installation. The upper boundry is an input variable. The abscissa represents the simulated time period. The lower and upper boundries of the abscissa are input variables.

identified, program control is transferred to one of several program routines corresponding to individual four-digit codes.

d. When word 2 is found to equal 3, the end of simulation has been reached. A final report is issued and CARGO terminates.

TABLE 7-1
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
1	0		F		V						Report interval.	CNT	E	
2	0	I			V	(Fig.	4-1)				Number of installations contained in the simulation.	BASE	E	
3	0	I			V	4-3	1				Number of reparables contained in the simulation.	NRPS	E	
4	2	I		Z				3	2		Sum of the tonnage arriving at each installation.	TTON		A
5	2	I		Z				3	2		Sum of the volume arriving at each installation.	TVOL		A
6	2	I		Z				3	2		Sum of the units arriving at each installation.	TUNT		A
7	2	I		Z				3	2		Sum of the installation units arriving at an installation.	TDPO		A
8	2	I		Z				3	2		Sum of the depot units arriving at an installation.	TBAS		A
9	0		F	Z							Program debugging aid.	LNT		A
10	1	I			V	4-3	2	3			Specify the weight of each reparable contained in the simulation.	WHT		A
11	2	I		Z				3	2		Internal variable.	FRPQ		A
12	2	I		Z				3	2		Internal variable.	LRPQ		A
13	1	I			V	4-3	2	3			Specify the volume of each reparable.	VOL		A
14	0	I			V						First installation to be printed by this report.	FBSET		A
15	0	I			V						Last installation to be printed by this report.	LBSET		A
16	1	I			V			2			Desired sequence of installation numbers to be printed.	SBSET		A
17	1	I		Z				2			Internal variable.	FBREP		A
18	1	I		Z				2			Internal variable.	LBREP		A
19	0	I			V						Data tape number.	IDAT		A
20	0	I			V						Type output desired: 0 = Graphic. 1 = Printed. 2 = Printed and graphic.	* OPTNS		A
21	0	I		Z							Program data. Initialize to zero.	* POINT		A
22	1	I		Z							Sum of total weight delivered to an installation.	* TONON		A
23	1	I		Z							Sum of total weight shipped to an installation.	* TONOF		A
24	1	I		Z							Sum of total volume delivered to an installation.	* VOLON		A
25	1	I		Z							Sum of total volume shipped from an installation.	* VOLOF		A
26	1	I		Z							Sum of total units delivered to an installation.	* QTYON		A

TABLE 7-1 CONTINUED
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
27	1	I		Z							Sum of total units shipped from an installation.	* QTYOF		A
28	1		F	Z							Value used in plotting quantity onloaded curve.	* AVQON		A
29	1		F	Z							Value used in plotting quantity offloaded curve.	* AVQOF		A
30	0	I		Z							Program data. Initialize to zero.	* PLOTS		A
31	0		F		V						Lower boundry of the abscissa. Enter time period plotting is to begin.	* XL		A
32	0		F		V						Upper boundry of the abscissa. Enter time period plotting is to end.	* XR		A
33	0		F		V						Upper boundry of the ordinate. Enter maximum number units onloaded and offloaded during simulation.	* YT		A
34	0	I			V						Number of installations for which graphs are to be produced.	* GRAPH	E	
35	0	I			V						Program data. Initialize to 7	* SEVEN	E	
36	0	I			V						Program data. Initialize to 7.	* SEVEN	E	
37	0	I			V						Program data. Initialize to 6.	* SIX	E	
38	0	I			V						Program data. Initialize to 6.	* SIX2	E	
39	0	I			V						Program data. Initialize to 6.	* SIX3	E	
40	0	I			V						Program data. Initialize to 5.	* FIVE	E	
41	0	I			V						Program data. Initialize to 5.	* FIVE2	E	
42	0	I			V						Program data. Initialize to 5.	* FIVE3	E	
43	0	I			V						Program data. Initialize to 5.	* FIVE4	E	
44	0	I			V						Program data. Initialize to 5.	* FIVE5	E	
45	0	I			V						Program data. Initialize to 5.	* FIVE6	E	
46	1	I			V			34			Desired sequence of graphic reports – by installation.	* BASEI		A
47	1		F		V			34			Installation constant. Use alpha format 10(A2).	* BASEA		A
48	1		F		V			35			Graph title data. Format 7(A6).	* TOPHD		A
49	1		F		V			36			Quantity onloaded/offloaded scale title. Format 7(A6).	* SIDHD		A
50	1		F		V			37			Literal constant to be printed at bottom of graph. Format 6(A6).	* BOTLI		A

TABLE 7-1 CONTINUED
VARIABLE DESCRIPTION AND INITIALIZATION LIST

ARRAY NUMBER	NUMBER OF SUBSCRIPTS	MODE		INITIALIZE TO		INITIALIZE VALUE IN		ARRAY NUMBER OF ATTRIBUTE TO BE ENTERED IN FIG. 3-3 COL.		LIST PACKING	DESCRIPTION OF VARIABLE TO BE INITIALIZED	PERMANENT SYSTEM VARIABLE NAME	ENTITY	ATTRIBUTE
		INTEGER	FLOATING POINT	ZERO	VALUE	TABLE	COL	19-22 (ROWS)	27-30 (COLS)					
51	1		F		V			38			Literal constant to be printed at bottom of graph. Format 6(A6).	BOTL2*		A
52	1		F		V			40			Literal constant to be printed at bottom of graph. Format 5(A6).	BTLHQ*		A
53	1		F		V			41			Literal constant to be printed at bottom of graph. Format 5(A6).	BTRHQ*		A
54	1		F		V			42			Literal constant to be printed at bottom of graph. Format 5(A6).	BTLHT*		A
55	1		F		V			43			Literal constant to be printed at bottom of graph. Format 5(A6).	BTRHT*		A
56	1		F		V			44			Literal constant to be printed at bottom of graph. Format 5(A6).	BTLHV*		A
57	1		F		V			45			Literal constant to be printed at bottom of graph. Format 5(A6).	BTRHV*		A
58	1		F		V			39			Constant data used in the identification frame routine by the plotter. Format 6(A6).	ADARY*		A
59	0	I		Z							Program data. Initialize to zero.	PNTOF*		A

Appendix A

LIMITATIONS

In general, computer simulation is a way of using a computer to produce a reasonable likeness of the behavior of a system under study. Simulation models are only representations of reality; of necessity, the system is "scaled down" to manageable size for the computer. As a result, simulation models are based on the designer's concept of what the key elements of the system are and how they operate and interact on the system.

The size and complexity of the problem that a manager would like to simulate increase as a function of the interrelationships to be considered. Computer memory size is a limiting factor in considering the size of the system to be simulated. The Depot Transportation Simulator object program on a UNIVAC 1108 requires approximately 13,000 words of core storage. Also, additional core storage is required for initialization data, temporary entities, and events. A very rough approximation of the unpacked core requirements for the initialization data for the problem to be simulated can be estamated by the following formula:

[3 (installations + parts + installations (carrier types)) + 4 (carrier types) + 6 (intervals/day (days))]

The Depot Transportation model is designed to examine the transportation requirements for a "special" system. A reparable cannot be transferred from carrier to carrier as it proceeds through the transportation network. Manning and equipment requirements for the transportation vehicles are not included. Similarly, while maintenance time distributions for the cargo carriers are included, manning and equipment required to perform the maintenance actions, as well as the ground and vehicle crews, are not treated explicitly. The intent of the maintenance time distribution is to reflect downtime or nonavailability time of the cargo carrier. If resource shortages are expected, the anticipated delays should be included in the maintenance time distributions.

Appendix B

EXAMPLE DATA--DEPOT TRANSPORTATION

```
1     X   180             777777
  1 137 0  Z
 138      0 R                                    21
 139      0 R                                    3
 140      0 R                                    8.0
 141      0 R                                    10
 142      0 R                                    17
 143      0 R                                    4
 144      0 R                                    6
 145      1 R      4 143          /2             4(I1)
3332
 146 151 1  Z    10 141          /2
 152      1 R     17 142          /2             12(I6)
011386 10386  8386  7768  8768  9768  7573  8573  9573 14449 14449   200
000200 14685 10462 10462 10462
 153      1 R     17 142          /2             17(I4)
0110 110  70 370 370 370 140 140 140 100 180  10  10 110  40  90  40
 154      1 R     17 142          /2             17(I1)
000444333000000000
 155      1 R      4 143          /2             4(I4)
0150 325 400 400
 156      1 R      4 143          /2             4(I6)
025000 25000 40000 10000
 157      0 R                                    1
 158      0 R                          U  L C 3(01.1,H1.1)
0.01.00.72.01.04.0                                                 3
 159      1 R      4 143                S L C 3(01.1,03.0)
0.0475.0.8550.1.0600.                                              3
0.0475.0.9550.1.0600.                                              3
0.0230.0.8250.1.0300.                                              3
0.0250.0.5300.1.0400.                                              3
 160      0 R                          U  L C 3(01.1,H1.1)
0.01.00.72.01.04.0                                                 3
 161      0 R                          U  L C 3(01.1,H1.1)
0.00.20.80.51.01.0                                                 3
 162      1 R     17 142                S L C 4(01.1,02.0)
0.001.0.602.1.005.                                                 3
0.002.0.703.1.005.                                                 3
0.004.0.506.1.008.                                                 3
0.002.0.803.1.006.                                                 3
0.002.0.708.1.010.                                                 3
0.005.0.610.1.011.                                                 3
0.010.0.715.1.020.                                                 3
0.012.0.518.1.020.                                                 3
0.011.0.616.1.020.                                                 3
0.010.0.815.1.018.                                                 3
0.010.1.018.                                                       2
0.003.0.404.0.608.1.009.                                           4
0.003.1.009.                                                       2
0.002.0.808.0.904.1.005.                                           4
```

Appendix B--Continued

```
0.002.0.606.1.010.                                                  3
0.001.1.004.                                                        2
0.001.0.903.1.020.                                                  3
 163     0  Z
 164     2 R     6 144   21 138  /4 R N          21(I1)
111111111111111111111
111111111111111111111
111111111111111111111
111111111111111111111
111111111111111111111
111111111111111111111
 165     1 R     4 143                          4(D6.0)
010000. 20000.  6000. 15000.
 166     1 R     4 143                    S L C 4(D1.1,H1.1)
0.00.50.81.01.01.0                                                  3
0.00.50.81.01.01.0                                                  3
0.00.50.71.01.01.5                                                  3
0.01.00.52.01.02.5                                                  3
 167     1 R     4 143                    S L C 4(D1.1,H1.1)
0.03.50.84.01.08.0                                                  3
0.03.50.84.01.08.0                                                  3
0.04.00.96.01.08.0                                                  3
0.02.00.54.01.05.0                                                  3
 168     1 R    10 141          /2              10(I5)
05850 5850 5040 5280 6720 4980 4590 4560 7050 7290
 169     1 R    10 141          /2              10(I5)
02100 1740 2400 1860 2460 1920 2400 2610 2040 2280
 170 171 1  Z   10 141          /2
 172 173 1  Z   10 141          /2
 174     0  Z
 175     0  Z
 176     0 R                                    40
 177     1 R    40 176                    SS I  3(D1.2,I1)
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.3000.5010.202                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0000.0021.001                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.3000.5010.202                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.4000.5010.102                                                     3
0.0000.0011.002                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
0.0010.0021.000                                                     3
```

Appendix B--Continued

```
0.0010.0021.000                                                    3
0.0010.0021.000                                                    3
0.0010.0021.000                                                    3
0.0010.0021.000                                                    3
 178      0 R                              U  L C 3(P1.1,H1.1)
0.00.20.50.41.00.8                                                 3
 179      1 R    17 142          /2              17(11)
33322211133333333
 180      0 R                                    6

016000000000
01800000000016
0101003
0102003
0201001
0202001
0501001
0502001
0801001
0802001
0901001
0902001
0503001
0703001
0803001
1004001
0104001
0204001
01900000030001      10507000З
 19        3  02    1 6 8   2
 19        3  03    1 7 9   2
 19        3  04    1 510   1
 19        3  05    1 2 1   1
 19        3  06    1 3 2   1
 19        3  07    1 7 5   1
 19        3  08    1 6 7   1
 19        3  09    1 4 8   1
 19        3  10    1 6 9   5
 19        3  11    1 210   3
 19        3  12    1 3 1  10
 19        3  13    1 7 2  20
 19        3  14    1 9 5   4
 19        3  15    110 7   6
 19        3  16    1 4 8   3
 19        3  17    1 6 1   5
0170000220001010501O3.000
0501.038
1001.170
0901.295
0201.503
0101.916
01700002340010202020l.000
0201.232
0101.986
01700010085008010603O7.000
0701.461
0301.579
0101.760
0502.020
1002.194
0802.368
 1900010120001      10507000З
 19     1 12   02   1 6 8   2
 19     1 12   03   1 7 9   2
 19     1 12   04   1 510   1
 19     1 12   05   1 2 1   1
 19     1 12   06   1 3 2   1
 19     1 12   07   1 7 5   1
 19     1 12   08   1 6 7   1
 19     1 12   09   1 4 8   1
```

```
19     1 12   10       1 8 9    5
19     1 12   11       1 210    3
19     1 12   12       1 3 1   10
19     1 12   13       1 7 2   20
19     1 12   16       1 4 8    3
19     1 12   17       1 6 1    5
19     1 12   14       1 9 5    4
19     1 12   15       110 7    6
1700010163008010400403.000
0301.843
0502.163
1002.343
0802.687
01700010224509010405 01.000
1002.072
0502.204
0902.907
0202.420
01900020000001         105070003
019    2 00   02       1 6 8    2
019    2 00   03       1 7 9    2
019    2 00   04       1 510    1
019    2 00   05       1 2 1    1
019    2 00   06       1 3 2    1
019    2 00   07       1 7 5    1
019    2 00   08       1 6 7    1
019    2 00   09       1 4 8    1
019    2 00   10       1 6 9    5
019    2 00   11       1 210    3
019    2 00   12       1 3 1   10
019    2 00   13       1 7 2   20
019    2 00   14       1 9 5    4
019    2 00   15       110 7    6
019    2 00   16       1 4 8    3
019    2 00   17       1 6 1    5
01700020160050105060. 000
0102.875
0303.055
0703.173
0803.309
0503.666
0170003000005020407 02.000
0103.541
0303.722
0803.899
0504.333
01900030100001         1 3070003
019    3 10   02       1 6 8    2
019    3 10   03       1 7 9    2
019    3 10   04       1 510    1
019    3 10   05       1 2 1    1
019    3 10   06       1 3 2    1
019    3 10   07       1 7 5    1
019    3 10   08       1 6 7    1
019    3 10   09       1 4 8    1
019    3 10   10       1 6 9    5
 19      10   11       1 210    3
019    3 10   12       1 3 1   10
019    3 10   13       1 7 2   20
019    3 10   14       1 9 5    4
019    3 10   15       110 7    6
```

Appendix B--Continued

```
019    3 10   16      1 4 8    3
019    3 10   17      1 6 1    5
01700040020001010508O1.000
0304.263
0704.381
0604.534
0404.645
0105.083
01700040120002010509O1.000
0404.652
0604.753
0704.906
0305.024
0205.500
01700040200001010410O1.000
0405.006
0605.107
0705.302
0105.833
01700040203010020411O2.000
0105.145
0605.343
0105.458
1005.854
01700040212009010412O1.000
0505.041
0305.354
0705.458
0905.868
019000501200O1        105070003
019    5 12   02      1 6 8    2
019    5 12   03      1 7 9    2
019    5 12   04      1 510    1
019    5 12   05      1 2 1    1
019    5 12   06      1 3 2    1
019    5 12   07      1 7 5    1
019    5 12   08      1 6 7    1
019    5 12   09      1 4 8    1
019    5 12   10      1 6 9    5
019    5 12   11      1 210    3
019    5 12   12      1 3 1   10
019    5 12   13      1 7 2   20
019    5 12   14      1 9 5    4
019    5 12   15      110 7    6
019    5 12   16      1 4 8    3
019    5 12   17      1 6 1    5
01700050202007030513O3.000
0606.000
0406.111
0206.263
0906.472
0706.847
019000801500O1        105070003
019    8 15   02      1 6 8    2
019    8 15   03      1 7 9    2
019    8 15   04      1 510    1
019    8 15   05      1 2 1    1
019    8 15   06      1 3 2    1
019    8 15   07      1 7 5    1
019    8 15   08      1 6 7    1
019    8 15   09      1 4 8    1
019    8 15   10      1 8 9    5
019    8 15   11      1 210    3
019    8 15   12      1 3 1   10
019    8 15   13      1 7 2   20
019    8 15   14      1 9 5    4
019    8 15   15      110 7    6
019    8 15   16      1 4 8    3
019    8 15   17      1 6 1    5
004003500000
```

Appendix C

EXAMPLE DATA--LIST

```
0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
1    P    33     0     0     0     0     0     0     0     LIST
   1  22 0  Z    0   0   0   0 0 0     0
  23   0 0 R     0   0   0   0 0 0     0         0                      LFLAG
  24   0 0 R     0   0   0   0 0 0     0          0.0                   START
  25   0 0 R     0   0   0   0 0 0     0          999.99999             STOP
  26   0 0 R     0   0   0   0 0 0     0          1                     SLK
  27   0 1 R     1  26   0   0 0 2     0          (I4)                  SEL
   3
  28   0 0 R     0   0   0   0 0 0     0         10                     BASES
  29   0 1 R    10  28   0   0 0 2     0         10(I2)                 BASE
01020304050607080910
  30   0 0  Z    0   0   0   0 0 0     0                                BFLAG
  31   0 0 R     0   0   0   0 0 0     0          9                     IDAT
  32   0 0 R     0   0   0   0 0 0     0          12                    TWELV
  33   0 1 R    12  32   0   0 0 0     0          12(A6)                AL
                    D T SIMULATOR OUTPUT
   0   0 0       0   0   0   0 0 0     0
```

Appendix D

EXAMPLE DATA--UTILIZATION

```
0        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
1    X    29     0     0777777     0     0     0     0
   1   0 0 R     0   0   0   0 0 0     0         1.0
   2   0 0 R     0   0   0   0 0 0     0         4
   3   6 1  Z    4   2   0   0 0 2     0
   7   0 0 R     0   0   0   0 0 0     0         1
   8   0 0 R     0   0   0   0 0 0     0         4
   9   0 1 R     4   2   0   0 0 0     0         4(I2)

  10   0 0 R     0   0   0   0 0 0     0         9
  11   0 0 R     0   0   0   0 0 0     0         1
  12   0 0  Z    0   0   0   0 0 0     0
  13   0 1  Z    4   2   0   0 0 0     0
  14   0 0  Z    0   0   0   0 0 0     0
  15   0 0 R     0   0   0   0 0 0     0         0.0
  16   0 0 R     0   0   0   0 0 0     0         35.0
  17   0 0 R     0   0   0   0 0 0     0         4
  18   0 0 R     0   0   0   0 0 0     0         2
  19   0 0 R     0   0   0   0 0 0     0         4
  20   0 0 R     0   0   0   0 0 0     0         5
  21   0 0 R     0   0   0   0 0 0     0         6
  22   0 1 R     4  17   0   0 0 4     0         4(I1)
1234
  23   0 1 R     4  17   0   0 0 0     0         4(A1)
1234
  24   0 1 R     6  21   0   0 0 0     0         6(A6)
UR2400    UNIVAC             050470
  25   0 1 R     5  20   0   0 0 0     0         5(A6)
SUMMARY UTILIZATION REPORT
  26   0 1 R     2  18   0   0 0 0     0         2(A6)
VEHICLE TYPE
  27   0 1 R     4  19   0   0 0 0     0         4(A6)
AVERAGE UTILIZATION RATE
  28   0 1 R     6  21   0   0 0 0     0         6(A6)
AVERAGE UTILIZATION RATE TO DATE  =
  29   0 0  Z    0   0   0   0 0 0     0
   0   0 0       0   0   0   0 0 0     0
```

Appendix E

EXAMPLE DATA--CARGO

```
1     X      59              777777
   1      0 R                                                      1.0
   2      0 R                                                      10                    0200
   3      0 R                                                      17                    0201
   4    8 2  Z     17    3  10    2                                                      0202
   9      0  Z                                                                           0203
  10      1 R      17    3                                         12(I6)                0204
011386 10386  8386  7768  8768  9768  7573  8573  9573 14449 14449   200                 0205
000200 14685 10462 10462 10462                                                           0206
  11   12 2  Z     17    3  10    2                                                      0207
  13      1 R      17    3                                         17(I4)                0208
0110 110  70 370 370 370 140 140 140 100 180  10  10 110  40  90  40                     0209
  14      0 R                                                      1
  15      0 R
  16      1 R      10    2                                         10(I2)                0212
020304050607080910
  17   18 1  Z     10    2                                                               0214
  19      0 R                                                      9
  20      0 R                                                      1
  21      0  Z
  22   27 0  Z
  28   29 0  Z
  30      0  Z
  31      0 R                                                      0.0
  32      0 R                                                      35.0
  33      0 R                                                      100.0
  34      0 R                                                      10
  35      0 R                                                      7
  36      0 R                                                      7
  37      0 R                                                      6
  38      0 R                                                      6
  39      0 R                                                      6
  40      0 R                                                      5
  41      0 R                                                      5
  42      0 R                                                      5
  43      0 R                                                      5
  44      0 R                                                      5
  45      0 R                                                      5
  46      1 R     10  34                                           10(I2)
01020304050607080910
  47      1 R     10  34                                           10(A2)
01020304050607080910
  48      1 R      7  35                                           7(A6
    SUMMARY CARGO REPORT FOR INSTALLATION
  49      1 R      7  36                                           7(A6)
   AVERAGE QUANTITY ONLOADED/OFFLOADED
  50      1 R      6  37                                           6(A6)
 O = AVERAGE QUANTITY OFFLOADED
  51      1 R      6  38                                           6(A6)
  * = AVERAGE QUANTITY ONLOADED

  52      1 R      5  40                                           5(A6)
  AVERAGE QUANTITY ONLOADED =
  53      1 R      5  41                                           5(A6)
 AVERAGE QUANTITY OFFLOADED =
  54      1 R      5  42                                           5(A6)
  AVERAGE TONS ONLOADED     =
  55      1 R      5  43                                           5(A6)
 AVERAGE TONS OFFLOADED     =
  56      1 R      5  44                                           5(A6)
  AVERAGE VOLUME ONLOADED   =
  57      1 R      5  45                                           5(A6)
 AVERAGE VOLUME OFFLOADED   =
  58      1 R      6  39                                           6(A6)
OR2400     UNIVAC               060570
  59      0 R                                                      0
```

Appendix F

OUTPUT RECORD TABLE

DEPOT TRANSP. ROUTINE	TRANSACTION CODES IDR	TRANSACTION CODES IDD	SHIFT	DY/WK	S/WK	INSTALLATION NO.	VARIABLE 1	VARIABLE 2	VARIABLE 3	ID ADDRESSES	IDT	CURRENT SIMULATED TIME	COMMENTS
DSPCTL	50	5010	O→N	O→N	O→NN	N	O	O	O	Carr ID	O	NNNN.NNNNN	Begin minor maintenance.
DSPCTL	50	5015	/	/	/	/	O	O	O	/	O	/	End minor maintenance.
DSPCTL	50	5020	/	/	/	/	Rep ID	Rep Wt	Rep VOL	/	O	/	Begin upload, special run.
DSPCTL	50	5030	/	/	/	/	/	/	/	/	O	/	Begin upload, cyclic run.
DSPCTL	50	5040	/	/	/	/	O	O	Dist	/	O	/	Carrier dispatch.
DSPCTL	50	5050	/	/	/	/	O	O	O	/	O	/	Carrier arrival.
DSPCTL	50	5051	/	/	/	/	O	O	O	/	O	/	Carrier lost en route.
DSPCTL	50	5052	/	/	/	O	O	O	O	/	O	/	Carrier delayed.
DSPCTL	50	5060	/	/	/	N	Rep ID	Rep No.	O	/	O	/	Rep arrived at depot.
DSPCTL	50	5070	/	/	/	/	/	O	O	/	O	/	Rep arrived at installation.
DSPCTL	50	5080	/	/	/	/	O	O	O	/	O	/	Carrier available for new job.
DSPCTL	50	5090	/	/	/	/	O	O	O	/	O	/	Major carrier maintenance.
TRANZ	50	5100	/	/	/	/	Destin	Rep No.	O	Rep ID	O	/	Rep arrives at shipping dock.
MAINT	50	5200	/	/	/	/	Carr Type	O	O	Carr ID	O	/	End major maintenance.
CRGEN	50	5300	/	/	/	/	/	O	O	/	O	/	Carrier generation.
CYGEN	50	5301	/	/	/	Trip No.	O	O	O	O	O	/	Trip number.
DREND	50	5400	/	/	/	N	Rep Home Installation	Rep No.	O	Rep ID	O	/	End of repair at depot.
DSPCTL	50	5500	/	/	/	/	Rep ID	O	O	O	O	/	Exogenous rep installation arrival.
ENDSIM	50	3	O	O	O	O	O	O	O	O	O	/	End of simulation.

Appendix G

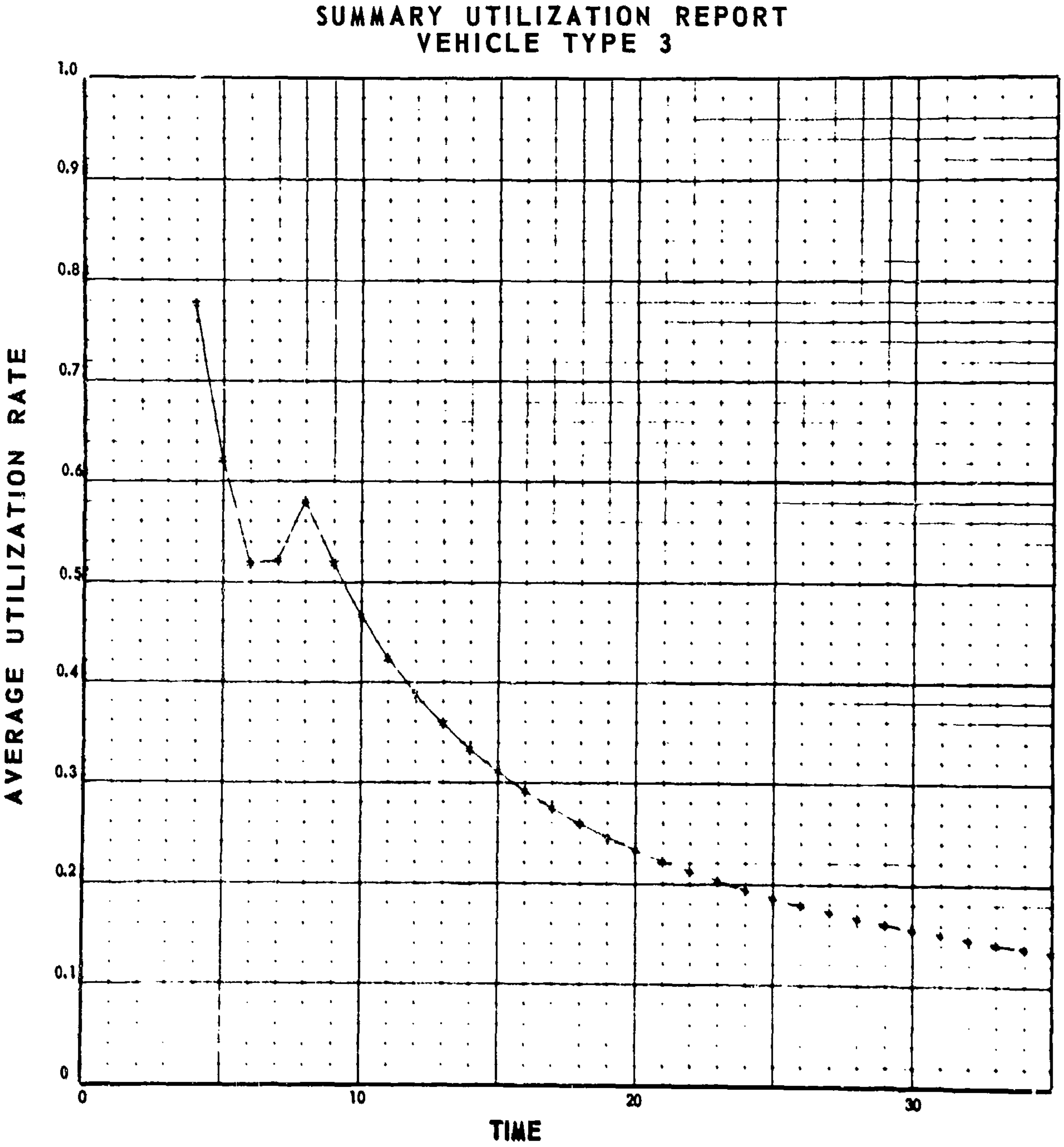
SAMPLE OUTPUT--LIST

D T SIMULATOR OUTPUT

50	5010	1	33	16	1	0	0	0	35887	0	33.01656
50	5050	1	33	16	7	0	0	0	35823	0	33.01969
50	5010	1	33	16	7	0	0	0	35823	0	33.01969
50	5015	1	33	16	1	0	0	0	35831	0	33.03641
50	5015	1	33	16	9	0	0	0	35927	0	33.03697
50	5030	1	33	16	9	3707114685		110	35927	0	33.03697
50	5015	1	33	16	2	0	0	0	35855	0	33.03710
50	5040	1	33	16	1	0	0	863	35895	0	33.03731
50	5015	1	33	16	1	0	0	0	35887	0	33.04470
50	5015	1	33	16	7	0	0	0	35823	0	33.05515
50	5030	1	33	16	7	36807	8573	140	35823	0	33.05515
50	5040	1	33	16	2	0	0	360	35855	0	33.05745
50	5040	1	33	16	1	0	0	863	35887	0	33.06515
50	5040	1	33	16	7	0	0	618	35823	0	33.06520
50	5400	1	33	16	7	5	1	0	37375	0	33.25034
50	5050	2	34	20	1	0	0	0	35855	0	34.34430
50	5080	2	34	20	1	0	0	0	35855	0	34.34430
50	5010	2	34	20	1	0	0	0	35855	0	34.34430
50	5040	2	34	20	1	0	0	360	35831	0	34.34530
50	5050	2	34	20	2	0	0	0	35847	0	34.34798
50	5010	2	34	20	2	0	0	0	35847	0	34.34798
50	5050	2	34	20	6	0	0	0	35823	0	34.34923
50	5050	2	34	20	7	0	0	0	35903	0	34.35040
50	5010	2	34	20	7	0	0	0	35903	0	34.35040
50	5050	2	34	20	3	0	0	0	35895	0	34.35213
50	5010	2	34	20	3	0	0	0	35895	0	34.35213
50	5040	2	34	20	9	0	0	534	35927	0	34.35266
50	5050	2	34	20	3	0	0	0	35887	0	34.36901
50	5010	2	34	20	3	0	0	0	35887	0	34.36901
50	5015	2	34	20	7	0	0	0	35903	0	34.37165
50	5030	2	34	20	7	3623911386		110	35903	0	34.37165
50	5015	2	34	20	1	0	0	0	35855	0	34.38122
50	5040	2	34	20	7	0	0	450	35903	0	34.38284
50	5015	2	34	20	2	0	0	0	35847	0	34.38919
50	5015	2	34	20	3	0	0	0	35887	0	34.39112
50	5015	2	34	20	3	0	0	0	35895	0	34.39379
50	5070	2	34	20	6	36807	8	0	35823	0	34.39532
50	5010	2	34	20	6	0	0	0	35823	0	34.39532
50	5040	2	34	20	2	0	0	360	35847	0	34.40600
50	5040	2	34	20	3	0	0	523	35895	0	34.40904
50	5040	2	34	20	3	0	0	450	35887	0	34.41106
50	5015	2	34	20	6	0	0	0	35823	0	34.41771
50	5040	2	34	20	6	0	0	305	35823	0	34.43085
50	5400	2	34	20	1	6	17	0	36351	0	34.59029
50	3	1	35	1	0	0	0	0	0	0	35.

Appendix H

SAMPLE OUTPUT--UTILIZATION



AVERAGE UTILIZATION RATE TO DATE = 0.133

Appendix H--Continued

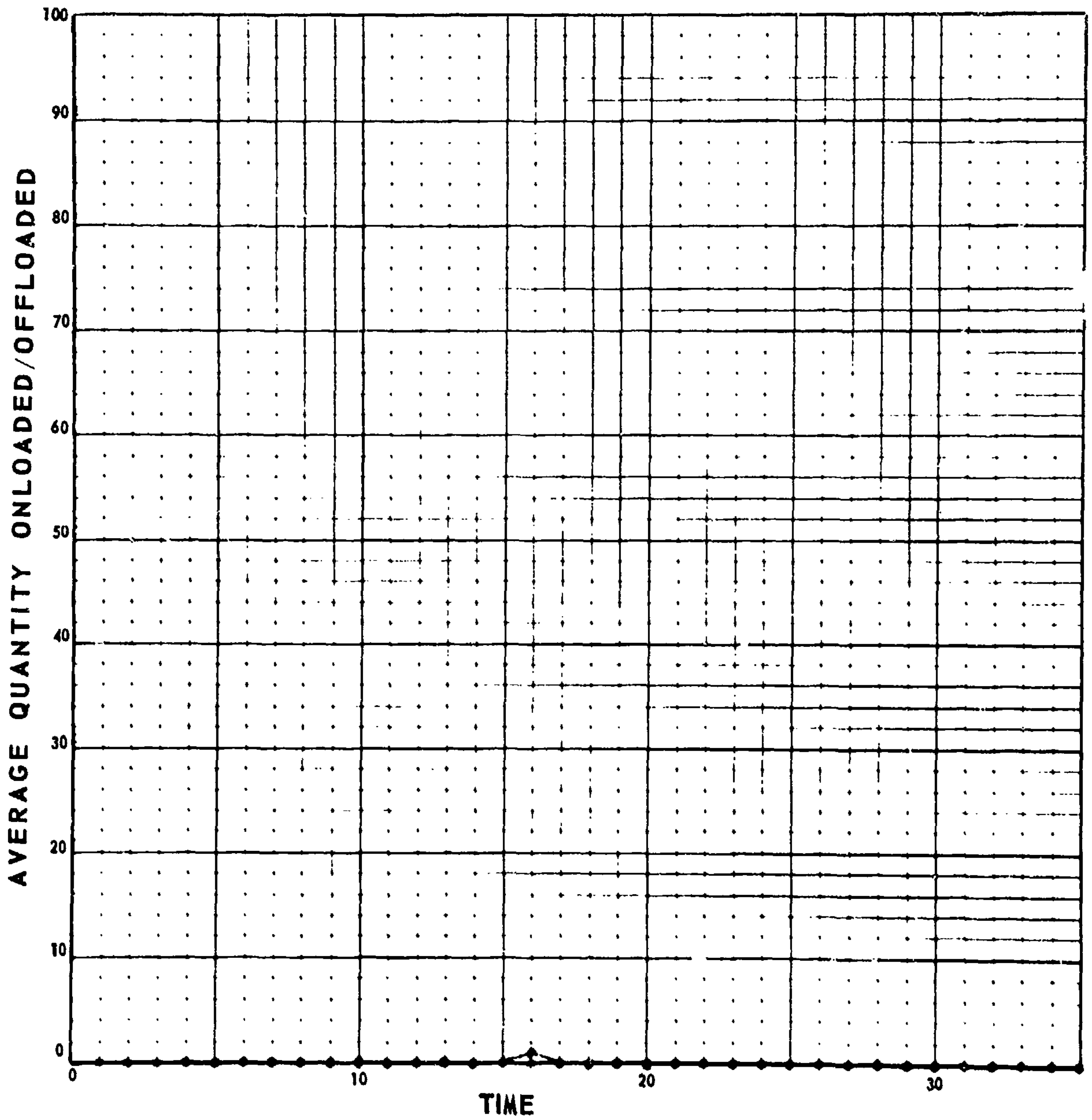
UTILIZATION OF VEHICLE TYPE 1 FOR PERIOD ENDING 1.

VEHICLE TYPE	VEHICLE ID	TIME AVAILABLE	MAINTENANCE DOWNTIME	LOADING TIME	IDLE TIME	UTILIZATION FACTOR
1	35807	1.	0.	0.	1.	0.
1	35815	1.	0.	0.	1.	0.
1	35823	1.	0.	0.	1.	0.
1	35863	1.	0.	0.	1.	0.
1	35887	1.	0.	0.	1.	0.
1	35903	1.	0.	0.	1.	0.
1	35927	1.	0.	0.	1.	0.

Appendix I

SAMPLE OUTPUT--CARGO

SUMMARY CARGO REPORT FOR INSTALLATION 01



* = AVERAGE QUANTITY ONLOADED

O = AVERAGE QUANTITY OFFLOADED

AVERAGE QUANTITY ONLOADED = 0.171
AVERAGE TONS ONLOADED = 0.285
AVERAGE VOLUME ONLOADED = 3.428

AVERAGE QUANTITY OFFLOADED = 0.171
AVERAGE TONS OFFLOADED = 0.285
AVERAGE VOLUME OFFLOADED = 3.428

Appendix I--Continued

CARGO REPORT FOR INSTALLATION 1 PERIOD ENDING 1.

CARGO TYPE	TONS DELIVERED		UNITS DELIVERED		VOLUME DELIVERED		INSTALLATION UNITS		DEPOT UNITS		IN PROCESS
	TP	TD	TP	TD	TP	TD	TP	TD	TP	TD	
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0

(AMCMA)

FOR THE COMMANDER:

OFFICIAL:

J. R. Groundwater
W. J. PHILLIPS
Colonel, GS
Chief, HQ Admin Mgt Ofc

CHARLES T. HORNER, JR.
Major General, USA
Chief of Staff

DISTRIBUTION:
AMCMA, AMCIG, AMCCP, AMCRD,
AMCMS, and AMCPA
B